

**RUBY-D716VG2AR**

**Industrial Motherboard  
ATX Board**

**User's Manual**

Version 1.0

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## How to Use This Manual

The manual describes how to configure your RUBY-D716VG2AR system board to meet various operating requirements. It is divided into five chapters, with each chapter addressing a basic concept and operation of Single Host Board.

**Chapter 1: System Overview.** Presents what you have in the box and give you an overview of the product specifications and basic system architecture for this series model of single host board.

**Chapter 2: Hardware Configuration.** Show the definitions and locations of Jumpers and Connectors that you can easily configure your system.

**Chapter 3: System Installation.** Describes how to properly mount the CPU, main memory and Compact Flash to get a safe installation and provides a programming guide of Watch Dog Timer function.

**Chapter 4: BIOS Setup Information.** Specifies the meaning of each setup parameters, how to get advanced BIOS performance and update new BIOS. In addition, POST checkpoint list will give users some guidelines of trouble-shooting.

**Chapter 5: Troubleshooting.** Provide various of useful tips to quickly get RUBY-D716VG2AR running with success. As basic hardware installation has been addressed in Chapter 3, this chapter will basically focus on system integration issues, in terms of backplane setup, BIOS setting, and OS diagnostics.

The content of this manual is subject to change without prior notice. These changes will be incorporated in new editions of the document. The vendor may make supplement or change in the products described in this document at any time

# Chapter 1

## System Overview

### 1.1 Introduction

Powell Inc., a world-leading innovator in the Industrial PC (IPC) market and a member of the Intel® Communications Alliance, has launched its new RUBY-D716VG2AR in response to market demand for a simplified embedded system board (ESB) that combines a smaller footprint, lower power consumption, robust computing power and with longevity support.

Against the pre-generation chipset RUBY-D716VG2AR based on Q87 chipset, Q87 offers Core i5/i7 processors, VGA, DVI-D, HDMI port, USB 3.0 and SATA III support which USB 3.0 is first integrated.

RUBY-D716VG2AR based on the Intel® Core™ Processor which offers 22nm Hi-K process technology with energy efficient architecture. RUBY- D716VG2AR adopts four channels DDR3 long DIMM up to 32GB.

Desktop solution is still popular in the market of DVR and Factory Automation which can fulfill most of these applications; therefore, with high performance and high-end specifications, Q87 is our first generation Ivy bridge chip architecture on ATX line.

### 1.2 Check List

The RUBY-D716VG2AR package should cover the following basic items

One RUBY-D716VG2AR Industrial Mother board

One SATA III Cable

One I/O Shield bracket

One Installation Resources CD-Title

If any of these items is damaged or missing, please contact your vendor and keep all packing materials for future replacement and maintenance.

### 1.3 Product Specification

- **Main Processor**

- Intel® Dual Core/Quad Core LGA1150 processor

- **Chipset**

- Intel® Q87 Express chipset

- **System BIOS**  
-Phoenix UEFI BIOS
- **Main Memory**  
-Four 240-pin DDR3 DIMM socket support up to 32GB dual channel 1600/1333MHz memory(supports Non-ECC memory)
- **Expansion Interface**  
-One PCIe x16 slot (Gen 3.0 8GT/s)  
-Two PCIe x4 slot  
-Two PCIe x1 slot  
-Two PCI slots
- **SATA Interface**  
-Five SATA ports(SATA 6Gb/s)  
-One CFEX (SATA 3Gb/s interface)
- **Serial Port**  
-Support total six com ports(one RS232 and one RS232/422/485 on rear S/O, three RS232 and one RS232/422/485 on board header)
- **USB Interface**  
-Support Twelve USB ports, four on rear I/O(USB3.0) and Eight on board header(USB2.0) for internal devices
- **Audio Interface**  
-Connector for Mic-In, Line-In and Line-Out
- **Real Time Clock/Calendar (RTC)**  
-Support Y2K Real Time Clock/Calendar
- **Watch Dog Timer**  
-Support WDT function through software programming for enable/disable and interval setting General system reset
- **On-board Ethernet LAN**  
-Two Gigabit Ethernet (10/100/1000 Mbits/sec) LAN ports using Intel WGI217LM & WGI210AT GbE Ethernet Controller
- **High Drive GPIO**  
-One pin-header for 8 bit GPIO(4bit in & 4bit out)
- **System Monitoring Feature**  
-Monitor system temperature and major power sources.
- **Outline Dimension (L x W)**  
-304.8mm (12") X 243.8mm (9.6")

- **Power Requirements**

Item	Power ON	Full Loading 10Min	Full Loading 30Min
<b>CPU +12V</b>	1.07A	1.83A	2.10A
<b>System +12V</b>	0.93A	1.28A	1.40A
<b>System +3.3V</b>	0.69A	0.93A	1.01A
<b>System +5V</b>	1.20A	2.02A	1.97A
<b>System+ Device +12V</b>	2.42A	3.42A	3.96A
<b>System+ Device +5V</b>	2.22A	2.81A	2.89A
<b>USB Loading Test</b>	<u>4.75~4.85V/ 580 mA</u>		

- **Configuration:**

<b>SBC BIOS</b>	Portwell, Inc. RUBY-D716VG2AR TEST BIOS
<b>VGA Card</b>	Intel Haswell HD Graphics -GT2
<b>VGA Driver</b>	Intel Haswell HD Graphics -GT2 Version:9.17.10.2895
<b>LAN Card</b>	Onboard Intel® I217-LM / I210 Gigabit Network Connection
<b>LAN Driver</b>	Intel® I217-LM/I210 Gigabit Network Connection Version:12.5.19.0 /12.4.36.
<b>Audio Card</b>	On board Realtek ALC886 High Definition Audio
<b>Audio Driver</b>	Realtek ALC886 High Definition Audio Version :6.0.1.6662
<b>Chip Driver</b>	Intel® Chipset Device Software Version:9.4.0.1011
<b>USB 3.0 Driver</b>	Intel® USB3.0 eXtensible Host Controller Version:2.0.2.100
<b>SATA HDD</b>	Seagate ST3250312CS 250GB
<b>Power Supply</b>	FSP GROUP INC, FSP350-60GLC

- **Operating Temperature**

0 °C ~ 60 °C

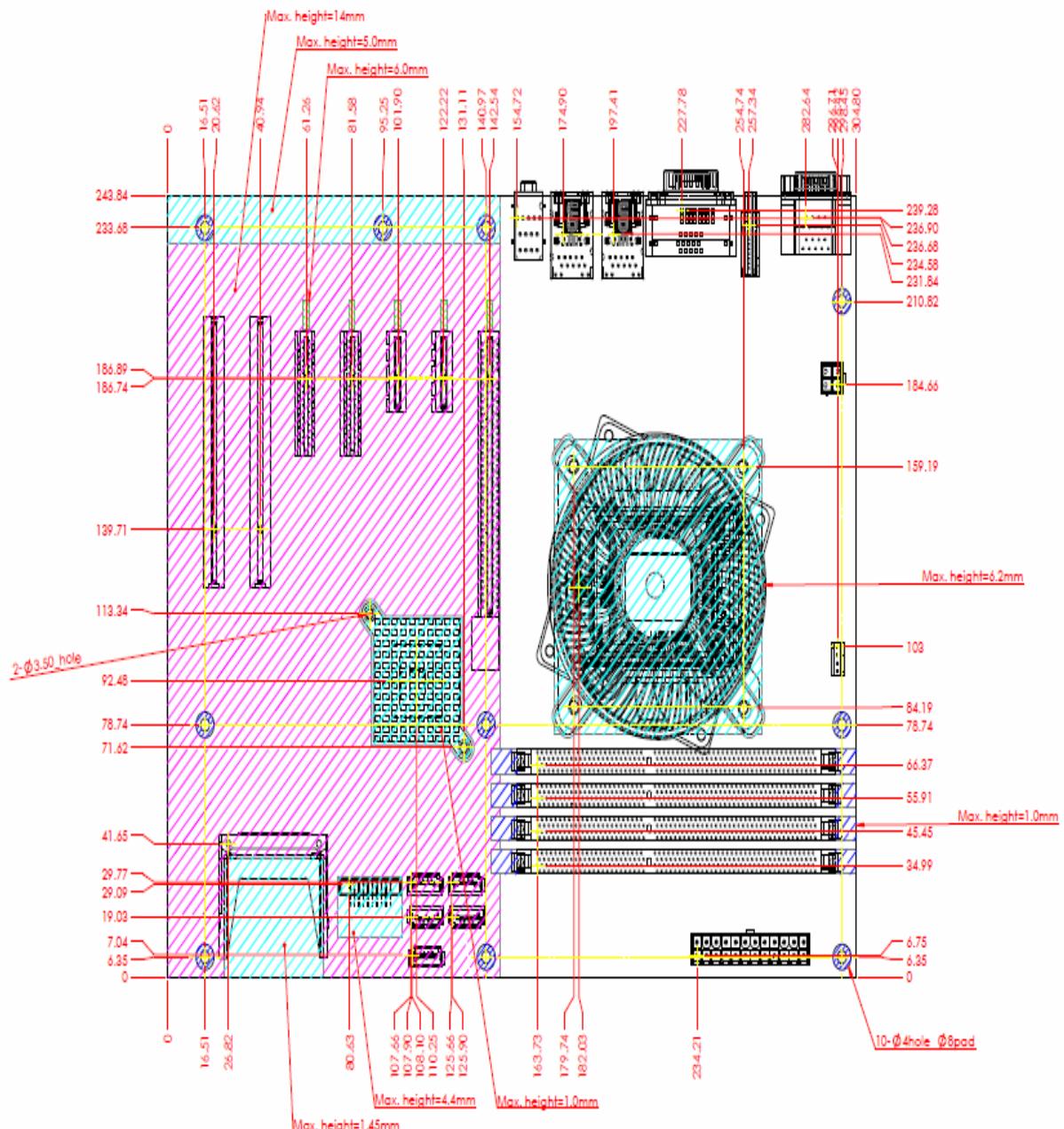
- **Storage temperature**

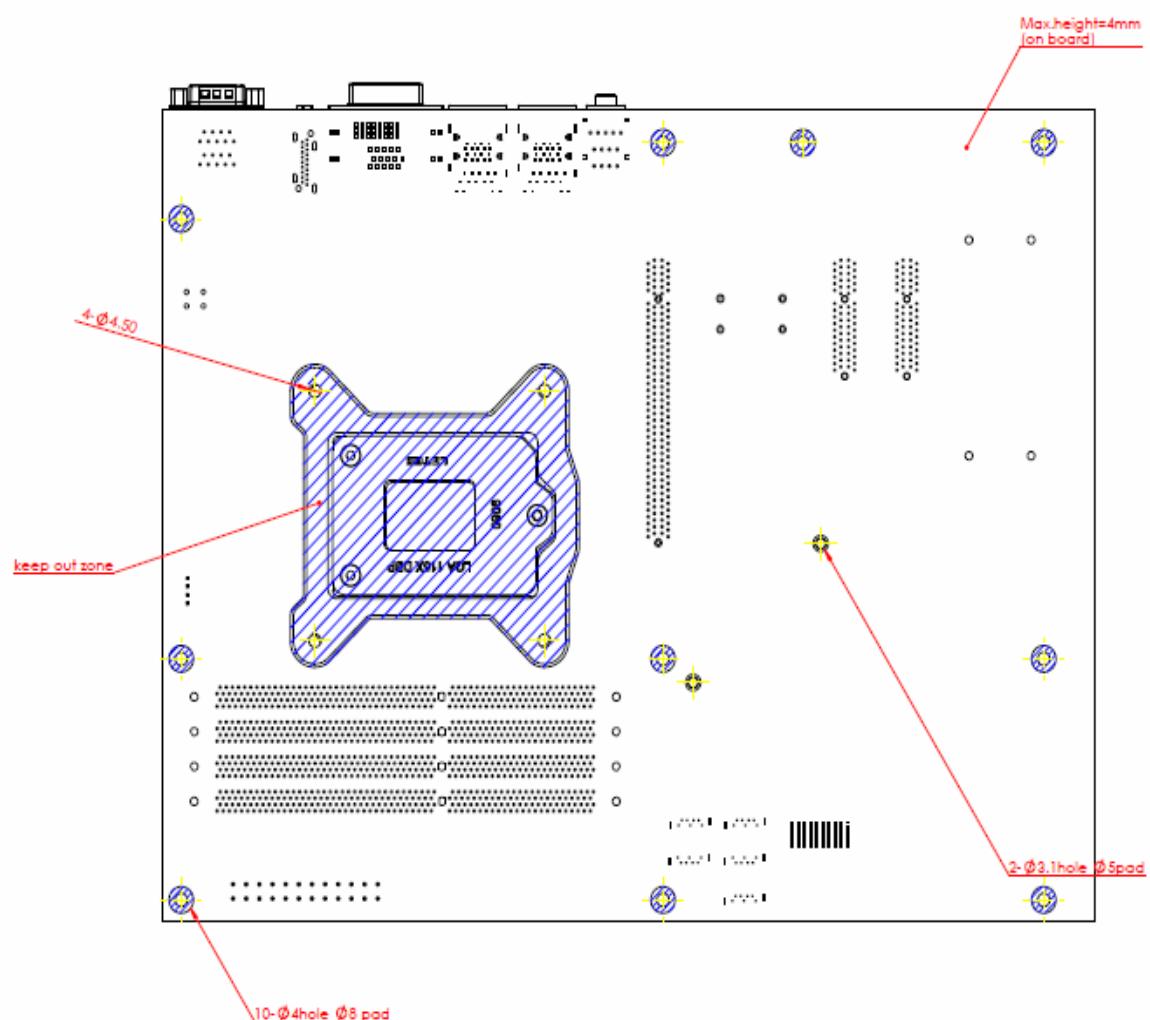
-20 ~ 80 °C

- **Relative Humidity**

0% ~ 90%, non-condensing

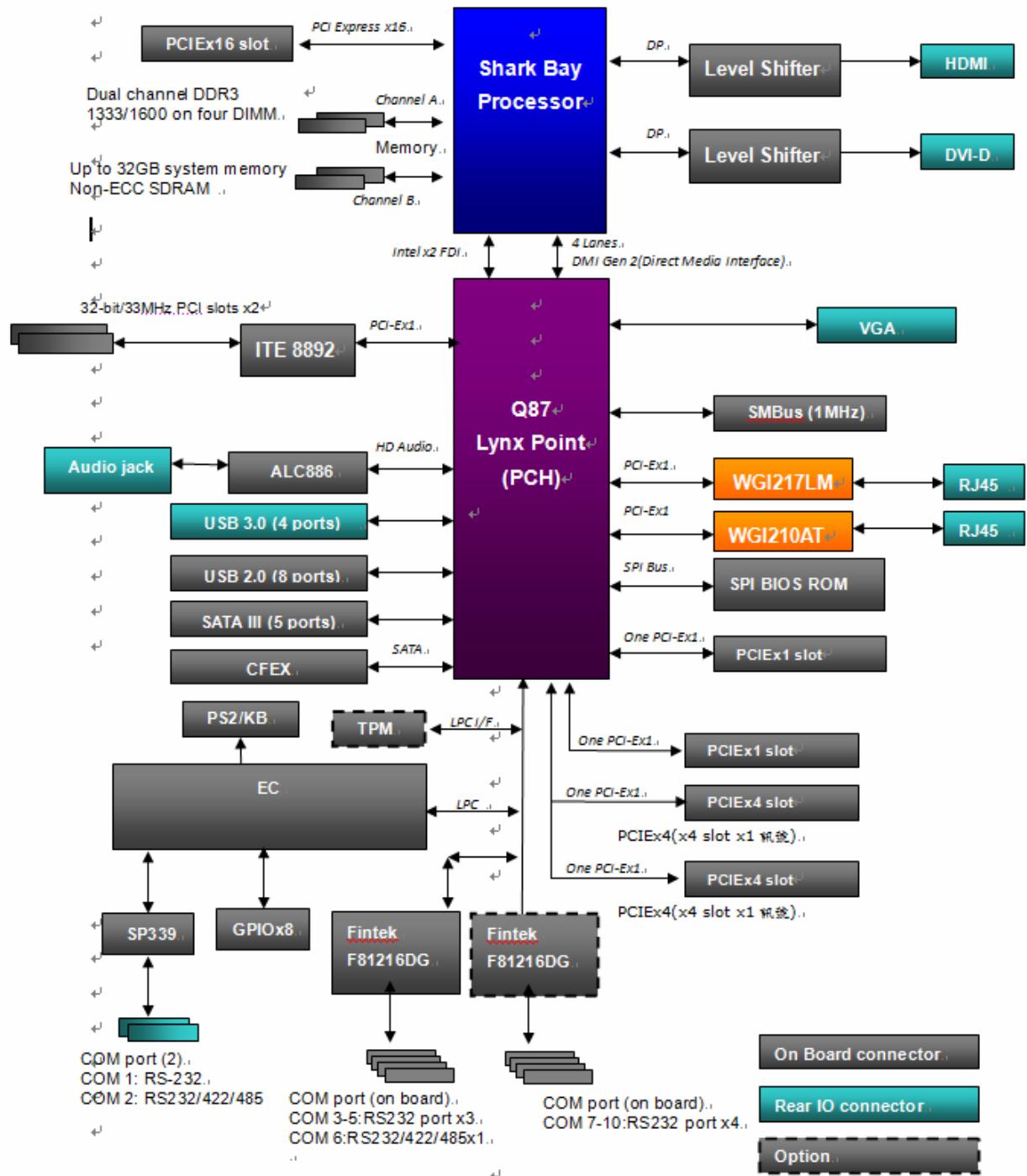
### 1.3.1 Mechanical Drawing





## 1.4 System Architecture

All of details operating relations are shown in RUBY-D716VG2AR System Block Diagram.



RUBY-D716VG2AR System Block Diagram

## Chapter 2

### Hardware Configuration

This chapter indicates jumpers', headers' and connectors' locations. Users may find useful information related to hardware settings in this chapter.

#### 2.1 Jumper Setting

For users to customize RUBY-D716VG2AR's features. In the following sections, Short means covering a jumper cap over jumper pins; Open or N/C (Not Connected) means removing a jumper cap from jumper pins. Users can refer to Figure 1 for the Jumper allocations.

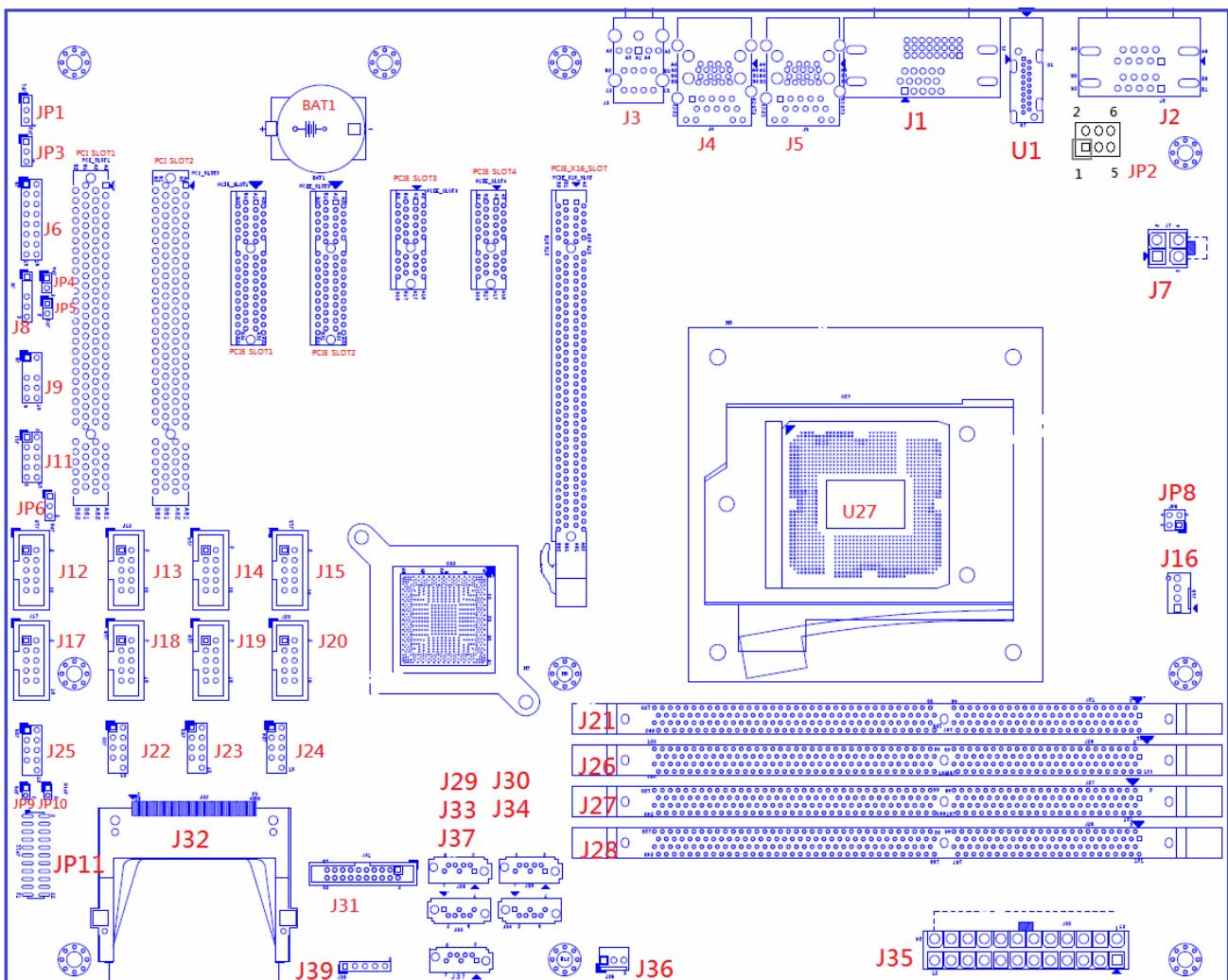


Figure 1-1 RUBY-D716VG2AR Top View

Jump Function List

Jump	Function	Remark
JP1	Clear CMOS	PH3Px1/2.54mm
JP2	COM Port1 RI POWER Select	Header3Px2/2mm
JP3	CONFIG / RECOVERY JUMPER	PH3Px1/2.54mm
JP4	Watch Dog Time Disable/Enable	PH2Px1/2.54mm
JP5	ATX & AT mode	PH2Px1/2.54mm
JP6	GPIO Out Level	PH3Px1/2.54mm
JP8	PCI Express* Bifurcation r	Header2Px2/2.54mm
JP11	COM Port6 mode Select	Header11Px2 2mm

Pin Assignments of ConnectorsJP1: Clear CMOS

PIN No.	Signal Description
1-2, Short	Normal ★
2-3, Short	Clear CMOS

JP2: COM Port1 RI POWER Select

PIN No.	Signal Description
1-2, Short	5V
3-4, Short	RI ★
5-6, Short	12V

J3: CONFIG / RECOVERY JUMPER

PIN No.	Signal Description
1-2, Short	NORMAL ★
2-3, Short	CONFIGURE
JUMPER REMOVED	RECOVERY

**JP4: Watch Dog Time Disable/Enable**

<b>PIN No.</b>	<b>Signal Description</b>
1-2 Short	Enable ★
1-2 Open	Disable

**JP5: ATX & AT mode**

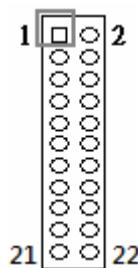
<b>PIN No.</b>	<b>Signal Description</b>
1-2 Short	AT mode
1-2 Open	ATX mode ★

**JP6: GPIO Out Level**

<b>PIN No.</b>	<b>Signal Description</b>
1-2, Short	5V
2-3, Short	3.3V

**JP8: PCI Express\* Bifurcation**

<b>PIN No.</b>	<b>Signal Description</b>
1-2, Short 3-4, Short	1x8 , 2x4
1-2, Open 3-4, Short	reserved
1-2, Short 3-4, Open	2x8
1-2, Open 3-4, Open	1x16 ★

**JP11: COM Port6 mode Select**

PIN No.	Signal Description
5-6,9-11,10-12, 15-17,16-18	RS-232 ★
3-4,7-9,8-10,13-15, 14-16,21-22	RS-422
1-2,7-9,8-10,19-20	RS-485

**2.2 Connector Allocation**

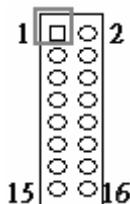
I/O peripheral devices are connected to the interface connectors.

**Connector Function List**

Connector	Function	Remark
U1	HDMI Port	
J1	DVI & VGA Port	QH11121-DBGH-4F. Foxconn
J2	COM Port 1 . 2	D-SUB 9Mx2
J3	Audio connector	Triple_AudioJack
J4	USB 3.0/100M/1G Lan Connector (LAN1) LAN WGI217LM	RJ45+USB3.0x2
J5	USB 3.0/100M/1G Lan Connector (LAN2) LAN WGI210AT	RJ45+USB3.0x2
J6	Front Panel System Connector	HEADER 8PX2
J7	ATX 4Pin 12V Power Connector	MA 2Px2. ATX4PT-L. TechBest
J8	SMBus Connector	PH5Px1-Pin2/2.54mm
J9	PS/2 Keyboard/Mouse Connector	HEADER5X2/nc3,4
J11	GPIO	Header5Px2/2.54mm
J12/J13/J14/J15 /J17/J18/J19/J20	COM3~COM10 Serial Port Connector	BH5Px2/2.54mm
J16	CPU FAN Power Connector	FAN_Header4Px1
J21/J26/J27/J28	DDR3 Long DIMM Connector	DDR3-Slot/240Pin
J25/J24/J23/J22	External USB Connector	HEADER 5PX2(-9)
J29/J30/J33/J34/J3 7	SATA Connector(6Gb/s)	SATA/Blue

J31	TPM(Trusted Platform Module) Connector	BH10Px2/2.0mm
J32	CFEX Slot	CFEX
J35	ATX Power	ATX24/180D
J36	SYSTEM FAN Power Connector	Connector3Px1/2.54mm

### J6: Front Panel System Connector

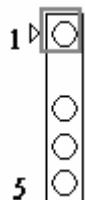


PIN No.	Signal Description	PIN No.	Signal Description
1	PWR_LED(+)	2	VCC
3	PWR_LED(-)	4	N/C
5	LAN1_ACT(+)	6	N/C
7	LAN1_LINK(-)	8	BUZZER
9	LAN2_LINK(-)	10	GND
11	LAN2_ACT(+)	12	Power Button
13	HDD_LED(+)	14	Rest
15	HDD_LED(-)	16	GND

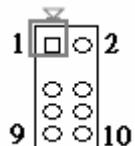
### J7: ATX 4Pin 12V Power Connector



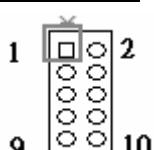
PIN No.	Signal Description
1	Ground
2	Ground
3	+12V
4	+12V

**J8: SMBus Connector**

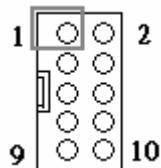
<b>PIN No.</b>	<b>Signal Description</b>
1	SMBus_CLK
2	N/C
3	Ground
4	SMBus_DAT
5	+5V

**J9: PS/2 Keyboard/Mouse Connector**

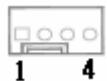
<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	Mouse Data	2	Keyboard Data
3	N/C	4	N/C
5	Ground	6	Ground
7	PS2 Power	8	PS2 Power
9	Mouse Clock	10	Keyboard Clock

**J11: GPIO**

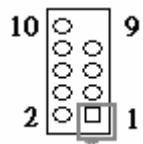
<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	LPC_GPIO0	2	LPC_GPO4
3	LPC_GPIO1	4	LPC_GPO2
5	LPC_GPIO2	6	LPC_GPO3
7	LPC_GPIO3	8	LPC_GPO4
9	GND	10	Vcc

J12/J13/J14/J15/J17/J18/J19/J20: COM3~COM10 Serial Port Connector

<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	DCD (Data Carrier Detect)	2	DSR (Data Set Ready)
3	RXD (Receive Data)	4	RTS (Request to Send)
5	TXD (Transmit Data)	6	CTS (Clear to Send)
7	DTR (Data Terminal Ready)	8	RI (Ring Indicator)
9	GND (Ground)	10	N/C

J16: CPU FAN Power Connector

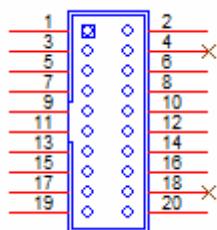
<b>PIN No.</b>	<b>Signal Description</b>
1	Ground
2	+12V
3	Fan on/off output
4	Fan Speed control

J25/J24/J23/J22: External USB Connector

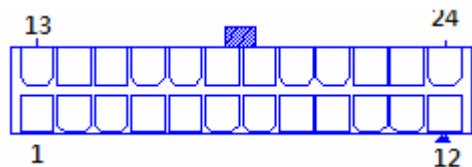
<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	5V Dual	2	5V Dual
3	USB-	4	USB-
5	USB+	6	USB+
7	Ground	8	Ground
9		10	N/C

**J29/J30/J33/J34/J37: SATA Connector(6Gb/s)**

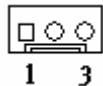
<b>PIN No.</b>	<b>Signal Description</b>
1	GND1
2	TX+
3	TX-
4	GND2
5	RX-
6	RX+
7	GND3

**J31 TPM(Trusted Platform Module) Connector**

<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	PCLK TPM	2	Ground
3	LFRAKE#	4	N/C
5	PLT_RST_N	6	LAD2
7	LAD3	8	LAD1
9	VCC3	10	Ground
11	LAD0	12	SMB_DATA_MAIN
13	SMB_CLK_MAIN	14	SERIRQ
15	3VSB	16	N/C
17	LPCPD#	18	LDRQ#1
19	Ground	20	Ground

**J35 ATX Power**

<b>PIN No.</b>	<b>Signal Description</b>	<b>PIN No.</b>	<b>Signal Description</b>
1	+3.3V	13	+3.3V
2	+3.3V	14	-12V
3	Ground	15	Ground
4	+5V	16	PS_ON#
5	Ground	17	Ground
6	+5V	18	Ground
7	Ground	19	Ground
8	ATX_PWOK	20	-5V
9	+5VSB	21	+5V
10	+12V1	22	+5V
11	+12V1	23	+5V
12	+3.3V	24	Ground

**J36: SYSTEM FAN Power Connector**

<b>PIN No.</b>	<b>Signal Description</b>
1	Ground
2	Fan speed control
3	Fan on/off output

## Chapter 3

# System Installation

This chapter provides the instructions to set up the system. The additional information is enclosed to help you set up onboard devices

### 3.1 Intel® Dual Core/Quad Core processor

#### LGA-1150 CPU Socket

Pin1 corner of the CPU Socket



#### LGA-1150 CPU

Yellow Triangle Pin1 of the CPU



Please remember to locate the alignment keys on the CPU socket of the motherboard and the notches on the CPU.

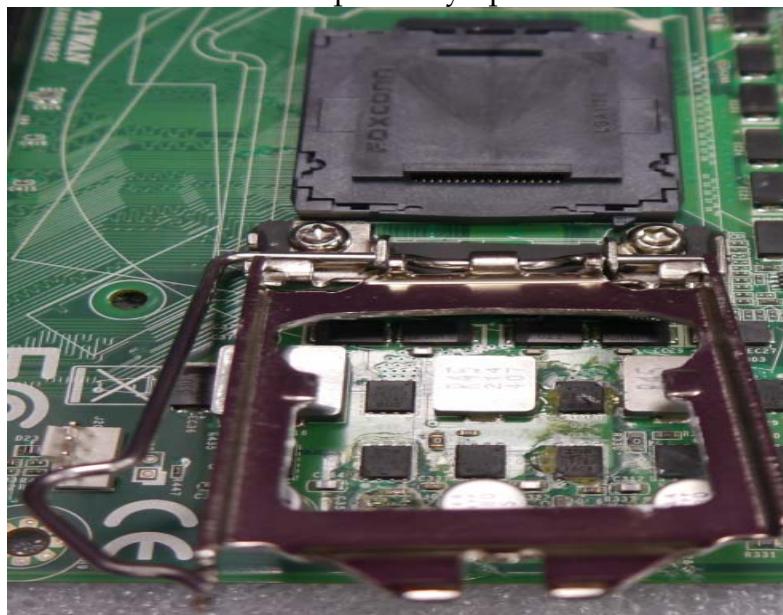
### LGA-1150 CPU Installation Steps

Before install the CPU, please make sure to turn off the power first!!

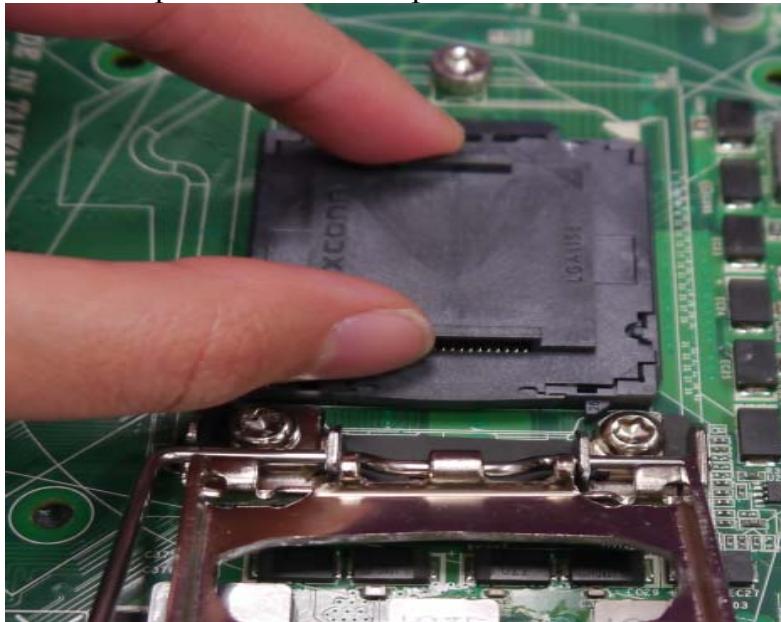
1. Open the load lever.



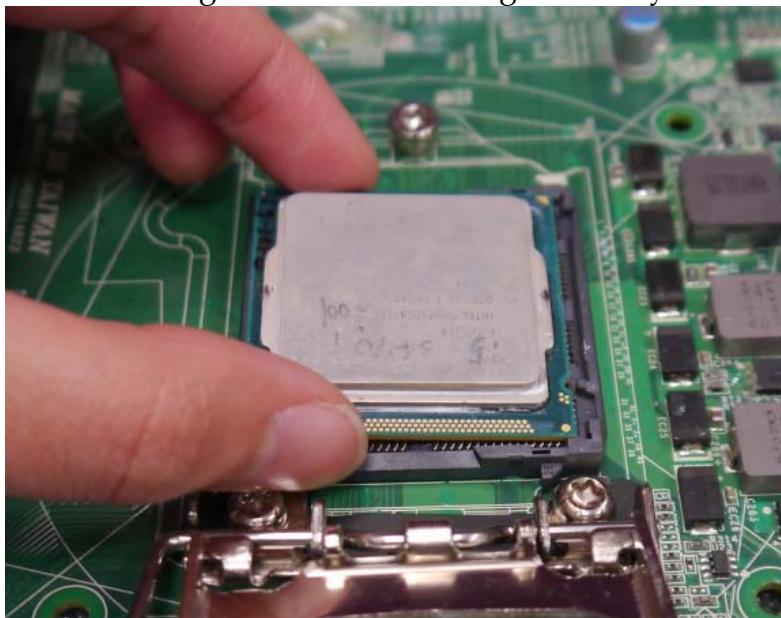
2. Lift the load lever up to fully open



3. Remove the plastic cap on the CPU socket. Before you install the CPU, always cover it to protect the socket pin.



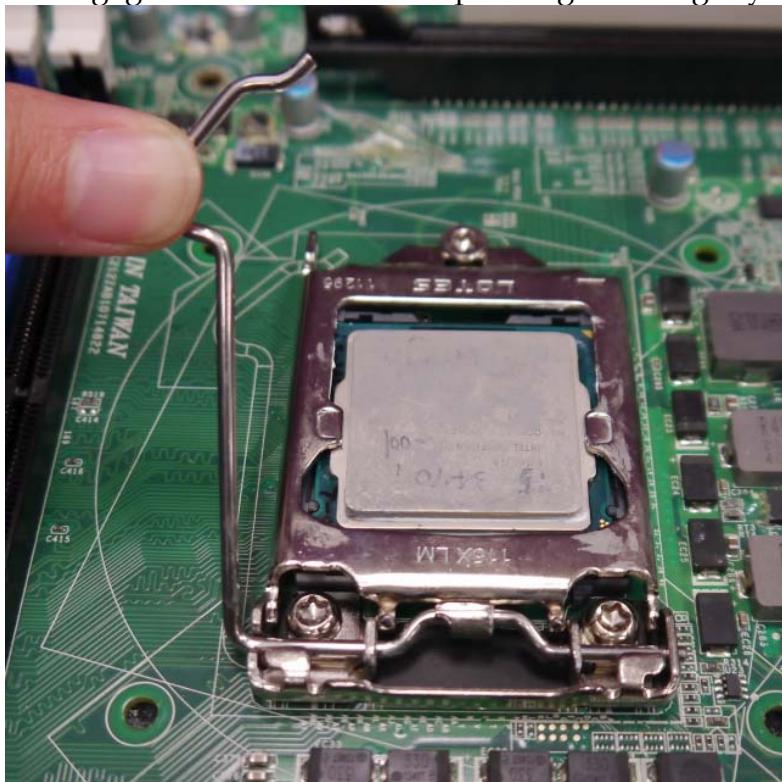
4. After confirming the CPU direction for correct mating, put down the CPU in the socket housing frame. Note that alignment keys are matched.



5. Make sure the CPU has been seated well into the socket. If not, take out the CPU and reinstall.



6. Engage the load lever while pressing down lightly onto the load plate.



7. Push the CPU socket lever back into its locked position



8. Please make sure four hooks are in proper position before you install the core.

### 3.2 Main Memory

RUBY-D716VG2AR provide 4 x240 pin DIMM sockets (Dual Channel) which supports Dual channel 1333/1600 DDR3-SDRAM as main memory, non-register function. RUBY-D716VG2AR just supports Non-ECC memory. The maximum memory can be up to 32GB. Memory clock and related settings can be detected by BIOS via SPD interface.

For system compatibility and stability, do not use memory module without brand. Memory configuration can be set to either one double-sided DIMM in one DIMM socket or two single-sided DIMM in both sockets.

Beware of the connection and lock integrity from memory module to socket. Inserting improperly it will affect the system reliability.

Before locking, make sure that all modules have been fully inserted into the card slots

**Note:**

To insure the system stability, please do not change any of DRAM parameters in BIOS setup to modify system the performance without acquired technical information.

### 3.3     **Installing the Single Board Computer**

To install your RUBY-D716VG2AR into standard chassis or proprietary environment, please perform the following:

Step 1 : Check all jumpers setting on proper position

Step 2 : Install and configure CPU and memory module at right position

Step 3 : Place RUBY-D716VG2AR into the dedicated position in the system

Step 4 : Attach cables to existing peripheral devices and secure it

#### **WARNING**

Please ensure that SBC is properly inserted and fixed by mechanism.

#### **Note**

Please refer to section 3.3.1 to 3.3.7 to install INF/VGA/LAN/Audio drivers.

#### **3.3.1    **Chipset Component Driver****

RUBY-D716VG2AR uses state-of-art Intel® Panther Point chipset. It's a new chipset that some old operating systems might not be able to recognize. To overcome this compatibility issue, for previous Windows Operating Systems such as Windows XP, please install its INF before any of other Drivers are installed. You can find very easily this chipset component driver in RUBY-D716VG2AR CD-title.

Moreover, if using some old OS, the driver may not be supported anymore. We recommend to change the different OS to comply with this new chipset.

#### **3.3.2    **Intel® HD Graphics Family****

With latest Intel® Core Ivy Bridge series structure, RUBY-D716VG2AR Intel® HD Graphic is built in with CPU. Therefore 2nd Generation Core and 3rd Generation Core CPUs provide HD integrated Graphic support sharing on board physical memories. RUBY-D716VG2AR has both internal VGA & DVI interface. This combination makes RUBY-D716VG2AR an excellent piece of multimedia hardware. With no additional video adaptor, this onboard video will usually be the system display output. By adjusting the BIOS setting to disable on-board VGA, an add-on PCI-Express Graphic card can take over the system display.

※To use Intel® Integrated HD Graphic, it's required to choose the CPU which has Integrated Graphic built-in. Otherwise there will be no display whatsoever.

#### **3.3.3    **Intel® PROSet Gigabit Ethernet Contolle****

#### **Drivers Support**

Please find Intel® WG1218LM and WG1210AT LAN driver in /Ethernet directory of RUBY-D716VG2AR CD-title. The driver supports Windows Win7 64-bits.

### 3.3.4 Audio Controller

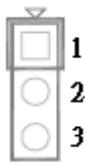
Please find Intel® High Definition Audio driver form RUBY-D716VG2AR CD-title. The driver supports Windows Win7 64-bits.

### 3.3.5 Intel® Active Management Technology (Intel® AMT)

Please find the latest Intel®AMT 9.0 driver from RUBY-D716VG2AR CD-title. The driver supports Windows Win7 64-bits.

## 3.4 Clear CMOS Operation

### JP1: CLEAR CMOS



PIN No.	Signal Description
1-2 Short	Normal Operation
2-3 Short	Clear CMOS Contents

## 3.5 WDT Function

The Watchdog Timer of motherboard consists of 8-bit programmable time-out counter and a control and status register.

### **WDT Controller Register**

There are two PNP I/O port addresses that can be used to configure WDT.

### **WDT Control Mode Register**

The working algorithm of the WDT function can be simply described as a counting process. The Time-Out Interval can be set through software programming. The availability of the time-out interval settings by software or hardware varies from boards to boards.

RUBY-D716VG2AR allows users to control WDT through dynamic software programming. The WDT starts counting when it is activated. It sends out a signal to system reset or to non-maskable interrupt (NMI), when time-out interval ends. To prevent the time-out interval from running out, a re-trigger signal will need to be sent before the counting reaches its end. This action will restart the counting process. A well-written WDT program should keep the counting process running under normal condition. WDT should never generate a system reset or NMI signal unless the system runs into troubles.

The related Control Registers of WDT are all included in the following sample program that is written in C language. User can fill a non-zero value into the Time-out Value Register to enable/refresh WDT. System will be reset after the Time-out Value to be counted down to zero. Or user can directly fill a zero value into Time-out Value Register to disable WDT immediately. To ensure a successful accessing to the content of desired Control Register, the sequence of following program codes should be step-by-step run again when each register is accessed.

Additionally, there are maximum 2 seconds of counting tolerance that should be considered into user' application program.

There are two PNP I/O port addresses that can be used to configure WDT,

### **WDT Control Command Example**

```
#include <stdio.h>
#include <dos.h>

#define EC_BASE 0x4E
#define EC_IO_BASE 0x2E

/* EC controll function */
static void EC_WriteByte (unsigned char index, unsigned char data)
{
    outportb (EC_BASE, index);
    delay(2);
    outportb (EC_BASE+1, data);
    delay(2);
}

/* Function to read value to SMFI via LPC */
```

```
static unsigned char EC_ReadByte (unsigned char index)
{
    unsigned char tmp;
    outportb (EC_BASE, index);
    delay(2);
    tmp = inportb (EC_BASE+1);
    delay(2);
    return tmp;
}

void EC_SetRamByte (int address, unsigned char data)
{
    int addr_HighByte, addr_LowByte;
    addr_HighByte = (address >> 8) & 0xFF;
    addr_LowByte = address & 0xFF;

    EC_WriteByte(EC_IO_BASE, 0x11);
    EC_WriteByte(EC_IO_BASE+1, addr_HighByte);

    EC_WriteByte(EC_IO_BASE, 0x10);
    EC_WriteByte(EC_IO_BASE+1, addr_LowByte);

    EC_WriteByte(EC_IO_BASE, 0x12);
    EC_WriteByte(EC_IO_BASE+1, data);
}

unsigned char EC_GetRamByte (int address)
{
    int addr_HighByte, addr_LowByte;
    addr_HighByte = (address >> 8) & 0xFF;
    addr_LowByte = address & 0xFF;

    EC_WriteByte(EC_IO_BASE, 0x11);
```

```
    EC_WriteByte(EC_IO_BASE+1, addr_HighByte);

    EC_WriteByte(EC_IO_BASE, 0x10);
    EC_WriteByte(EC_IO_BASE+1, addr_LowByte);

    EC_WriteByte(EC_IO_BASE, 0x12);
    return EC_ReadByte(EC_IO_BASE+1);

}

void ec_wdt_trigger ()
{
    EC_SetRamByte (0x308, 0x05); /* WDT Counter */
    EC_SetRamByte (0x306, 0x01); /* WDTCFG[1:0]=01 */
}

int main(void)
{
    int i;

    ec_wdt_trigger ();

    for (i = 0; i < 5; i++)
    {
        printf ("Reset counter .....%d\n", 5 - i);
        delay (1000);
    }
    return 0;
}
```

## 3.6 GPIO

The motherboard provides 4 input / output ports that can be individually configured to perform a simple basic I/O function.

### GPIO Pin Assignment

The RUBY-D716VG2AR provides 4 input/output ports that can be individually configured to perform a simple basic I/O function. Users can configure each individual port to become an input or output port by programming register bit of I/O Selection. To invert port value, the setting of Inversion Register has to be made. Port values can be set to read or write through Data Register.

The GPIO port is located on J11 shown as follows. Please note: Do not short the **Pin 9 and Pin 10 of the J11!**

The control for the GPIO signals is handled through a separate 1-byte I/O space.

### J11: General Purpose I/O Connector

PIN No.	Signal Description	PIN No.	Signal Description
1	GPIO0	2	GPIO4
3	GPIO1	4	GPIO5
5	GPIO2	6	GPIO6
7	GPIO3	8	GPIO7
9	GND	10	VCC

### GPIO Control Command Example (C Language)

```
#include <stdio.h>
#include <dos.h>

#define EC_BASE 0x4E
#define EC_IO_BASE 0x2E

#define EC_PIN1_VALUE_ADDR 0x160A /*bit 0*/
#define EC_PIN2_VALUE_ADDR 0x160A /*bit 1*/
#define EC_PIN3_VALUE_ADDR 0x160A /*bit 2*/
#define EC_PIN4_VALUE_ADDR 0x160A /*bit 3*/
#define EC_PIN5_VALUE_ADDR 0x1605 /*bit 0*/
#define EC_PIN6_VALUE_ADDR 0x1605 /*bit 7*/
#define EC_PIN7_VALUE_ADDR 0x1603 /*bit 0*/
#define EC_PIN8_VALUE_ADDR 0x1607 /*bit 0*/

#define EC_PIN1_CTL_ADDR 0x1658 //J0 ~ J3
#define EC_PIN2_CTL_ADDR 0x1659
#define EC_PIN3_CTL_ADDR 0x165A
#define EC_PIN4_CTL_ADDR 0x165B
```

```
#define EC_PIN5_CTL_ADDR      0x1630 // E0
#define EC_PIN6_CTL_ADDR      0x1637 // E7
#define EC_PIN7_CTL_ADDR      0x1620 // C0
#define EC_PIN8_CTL_ADDR      0x1640 // G0

#define EC_Bit0                0x01
#define EC_Bit1                0x02
#define EC_Bit2                0x04
#define EC_Bit3                0x08
#define EC_Bit4                0x01
#define EC_Bit5                0x80
#define EC_Bit6                0x01
#define EC_Bit7                0x01

/* EC controll function */
static void EC_WriteByte (unsigned char index, unsigned char data)
{
    outportb (EC_BASE, index);
    delay(2);
    outportb (EC_BASE+1, data);
    delay(2);
}

/* Function to read value to SMFI via LPC */
static unsigned char EC_ReadByte (unsigned char index)
{
    unsigned char tmp;
    outportb (EC_BASE, index);
    delay(2);
    tmp = inportb (EC_BASE+1);
    delay(2);
    return tmp;
}

void EC_SetRamByte (int address, unsigned char data)
{
    int addr_HighByte, addr_LowByte;
    addr_HighByte = (address >> 8) & 0xFF;
    addr_LowByte = address & 0xFF;

    EC_WriteByte(EC_IO_BASE, 0x11);
    EC_WriteByte(EC_IO_BASE+1, addr_HighByte);

    EC_WriteByte(EC_IO_BASE, 0x10);
    EC_WriteByte(EC_IO_BASE+1, addr_LowByte);
```

```

        EC_WriteByte(EC_IO_BASE, 0x12);
        EC_WriteByte(EC_IO_BASE+1, data);
    }

unsigned char EC_GetRamByte (int address)
{
    int addr_HighByte, addr_LowByte;
    addr_HighByte = (address >> 8) & 0xFF;
    addr_LowByte = address & 0xFF;

    EC_WriteByte(EC_IO_BASE, 0x11);
    EC_WriteByte(EC_IO_BASE+1, addr_HighByte);

    EC_WriteByte(EC_IO_BASE, 0x10);
    EC_WriteByte(EC_IO_BASE+1, addr_LowByte);

    EC_WriteByte(EC_IO_BASE, 0x12);
    return EC_ReadByte(EC_IO_BASE+1);
}

/* GPIO controll function */
int gpio_SetPindirection (int pin_num, unsigned char io_direction)
{
    unsigned char data;
    unsigned char tmp;

    switch (pin_num)
    {
        case 1:
            if(io_direction)
            {
                tmp = tmp &= 0x84;
                tmp |= ~0x40;
                EC_SetRamByte(EC_PIN1_CTL_ADDR, tmp);
            }
            else
            {
                tmp = tmp &= ~0x80;
                tmp |= 0x40;
                EC_SetRamByte(EC_PIN1_CTL_ADDR, tmp);
            }
    }
}

```

```
    EC_SetRamByte(EC_PIN1_CTL_ADDR, tmp);
    }
    break;
    case 2:
        if (io_direction)
        {
            tmp = EC_GetRamByte(EC_PIN2_CTL_ADDR);
            tmp = 0x84;
            tmp &= ~0x40;
            EC_SetRamByte(EC_PIN2_CTL_ADDR,
tmp);
        }
        else
        {
            tmp = EC_GetRamByte(EC_PIN2_CTL_ADDR);
            tmp = 0x40;
            tmp &= ~0x80;
            EC_SetRamByte(EC_PIN2_CTL_ADDR,
tmp);
        }
        break;
    case 3:
        if (io_direction)
        {
            tmp = EC_GetRamByte(EC_PIN3_CTL_ADDR);
            tmp = 0x84;
            tmp &= ~0x40;
            EC_SetRamByte(EC_PIN3_CTL_ADDR,
tmp);
        }
        else
        {
            tmp = EC_GetRamByte(EC_PIN3_CTL_ADDR);
            tmp = 0x40;
            tmp &= ~0x80;
            EC_SetRamByte(EC_PIN3_CTL_ADDR,
tmp);
        }
        break;
    case 4:
        if (io_direction)
```

```

    {
        tmp = EC_GetRamByte(EC_PIN4_CTL_ADDR);
        tmp = 0x84;
        tmp &= ~0x40;
        EC_SetRamByte(EC_PIN4_CTL_ADDR,
tmp);
    }
else
{
    tmp = EC_GetRamByte(EC_PIN4_CTL_ADDR);
    tmp = 0x40;
    tmp &= ~0x80;
    EC_SetRamByte(EC_PIN4_CTL_ADDR,
tmp);
}
break;
case 5:
    if (io_direction)
    {
        tmp = EC_GetRamByte(EC_PIN5_CTL_ADDR);
        tmp = 0x84;
        tmp &= ~0x40;
        EC_SetRamByte(EC_PIN5_CTL_ADDR,
tmp);
    }
else
{
    tmp = EC_GetRamByte(EC_PIN5_CTL_ADDR);
    tmp = 0x40;
    tmp &= ~0x80;
    EC_SetRamByte(EC_PIN5_CTL_ADDR,
tmp);
}
break;
case 6:
    if (io_direction)
    {
        tmp = EC_GetRamByte(EC_PIN6_CTL_ADDR);
        tmp = 0x84;
        tmp &= ~0x40;

```

```

EC_SetRamByte(EC_PIN6_CTL_ADDR,
tmp);
}
else
{
    tmp = EC_GetRamByte(EC_PIN6_CTL_ADDR);
    tmp = 0x40;
    tmp &= ~0x80;
    EC_SetRamByte(EC_PIN6_CTL_ADDR,
tmp);
}
break;
case 7:
    if (io_direction)
    {
        tmp = EC_GetRamByte(EC_PIN7_CTL_ADDR);
        tmp = 0x84;
        tmp &= ~0x40;
        EC_SetRamByte(EC_PIN7_CTL_ADDR,
tmp);
    }
    else
    {
        tmp = EC_GetRamByte(EC_PIN7_CTL_ADDR);
        tmp = 0x40;
        tmp &= ~0x80;
        EC_SetRamByte(EC_PIN7_CTL_ADDR,
tmp);
    }
}
break;
case 8:
    if (io_direction)
    {
        tmp = EC_GetRamByte(EC_PIN8_CTL_ADDR);
        tmp = 0x84;
        tmp &= ~0x40;
        EC_SetRamByte(EC_PIN8_CTL_ADDR,
tmp);
    }
    else
    {

```

```

tmp = EC_GetRamByte(EC_PIN8_CTL_ADDR);
tmp = 0x40;
tmp &= ~0x80;
EC_SetRamByte(EC_PIN8_CTL_ADDR,
tmp);
}
break;
default:
printf("invalid pin number when writing to
gpio\n");
}
return 0;
}

int gpio_setdirection (unsigned char io_direction)
{
    unsigned char data;
    int i;

    for (i = 0; i < 8; i++)
        gpio_setpindirection (gpio_set, i+1, (io_direction & (0x01 <<
i)));
    return 0;
}

int gpio_readpindirection (int pin_num, unsigned char *io_direction)
{
    unsigned char data;
    unsigned char tmp;

    switch(pin_num)
    {
        case 1:
            tmp = EC_GetRamByte(EC_PIN1_CTL_ADDR);
            if( tmp & 0x80 ) /* means in */
                *io_direction = 1;
            else if ( tmp & 0x40 ) /* means out */
                *io_direction = 0;
            else
                printf("unknown GPIO pin direction in
EC\n");
            break;
        case 2:
            tmp = EC_GetRamByte(EC_PIN2_CTL_ADDR);
}

```

```
        if( tmp & 0x80 )
            *io_direction = 1;
        else if ( tmp & 0x40 )
            *io_direction = 0;
        else
            printf("unknown GPIO pin direction in
EC\n");
        break;
case 3:
    tmp = EC_GetRamByte(EC_PIN3_CTL_ADDR);
    if( tmp & 0x80 )
        *io_direction = 1;
    else if ( tmp & 0x40 )
        *io_direction = 0;
    else
        printf("unknown GPIO pin direction in
EC\n");
    break;
case 4:
    tmp = EC_GetRamByte(EC_PIN4_CTL_ADDR);
    if( tmp & 0x80 )
        *io_direction = 1;
    else if ( tmp & 0x40 )
        *io_direction = 0;
    else
        printf("unknown GPIO pin direction in
EC\n");
    break;
case 5:
    tmp = EC_GetRamByte(EC_PIN5_CTL_ADDR);
    if( tmp & 0x80 )
        *io_direction = 1;
    else if ( tmp & 0x40 )
        *io_direction = 0;
    else
        printf("unknown GPIO pin direction in
EC\n");
    break;
case 6:
    tmp = EC_GetRamByte(EC_PIN6_CTL_ADDR);
    if( tmp & 0x80 )
        *io_direction = 1;
    else if ( tmp & 0x40 )
        *io_direction = 0;
    else
```

```

printf("unknown GPIO pin direction in
EC\n");
break;
case 7:
tmp = EC_GetRamByte(EC_PIN7_CTL_ADDR);
if( tmp & 0x80 )
    *io_direction = 1;
else if ( tmp & 0x40 )
    *io_direction = 0;
else
printf("unknown GPIO pin direction in
EC\n");
break;
case 8:
tmp = EC_GetRamByte(EC_PIN8_CTL_ADDR);
if( tmp & 0x80 )
    *io_direction = 1;
else if ( tmp & 0x40 )
    *io_direction = 0;
else
printf("unknown GPIO pin direction in
EC\n");
break;
default:
printf("unsupport pin number when read pin
direction\n");
}
return 0;
}

```

```
int gpio_readdir (int gpio_set, unsigned char *io_direction)
{
```

```
    int i;
    unsigned char data, temp, temp2;
```

```
    switch (gpio_set)
    {
        case 1:
            return 0;
        case 2:
            *io_direction = 0;
            for (i = 0; i < 8; i++)
            {
                gpio_readdir (2, i+1, &data);
                *io_direction |= (data << i);
            }
    }
}
```

```
        return 0;
    default:
        printf ("error: no read gpio direction\n");
        return 1;
    }
}

int gpio_readpin (int pin_num, unsigned char *value)
{
    unsigned char data;
    unsigned char tmp;
    int action;

    switch (pin_num)
    {
        case 1:
            tmp = EC_GetRamByte(EC_PIN1_VALUE_ADDR);
            if (tmp & 0x10) /* means high */
                *value = 1;
            else
                *value = 0;
            break;
        case 2:
            tmp = EC_GetRamByte(EC_PIN2_VALUE_ADDR);
            if( tmp & 0x40 ) /* means high */
                *value = 1;
            else
                *value = 0;
            break;
        case 3:
            tmp = EC_GetRamByte(EC_PIN3_VALUE_ADDR);
            if( tmp & 0x20 ) /* means high */
                *value = 1;
            else
                *value = 0;
            break;
        case 4:
            tmp = EC_GetRamByte(EC_PIN4_VALUE_ADDR);
            if( tmp & 0x08 ) /* means high */
                *value = 1;
            else
                *value = 0;
            break;
        case 5:
            tmp = EC_GetRamByte(EC_PIN5_VALUE_ADDR);
            if( tmp & 0x80 ) /* means high */

```

```

                *value = 1;
        else
                *value = 0;
        break;
    case 6:
        tmp = EC_GetRamByte(EC_PIN6_VALUE_ADDR);
        if( tmp & 0x01 )
                *value = 1;
        else
                *value = 0;
        break;
    case 7:
        tmp = EC_GetRamByte(EC_PIN7_VALUE_ADDR);
        if( tmp & 0x02 )
                *value = 1;
        else
                *value = 0;
        break;
    case 8:
        tmp = EC_GetRamByte(EC_PIN8_VALUE_ADDR);
        if( tmp & 0x04 )
                *value = 1;
        else
                *value = 0;
        break;
    default:
        printf("invalid pin number when reading from
gpio\n");
        return 1;
    }
}

int gpio_read (unsigned char *value)
{
    unsigned char temp, temp2;
    unsigned char pch_data, i;

    *value = 0;
    for (i = 0; i < 8; i++)
    {
        gpio_readpin (2, i+1, &pch_data);
        *value |= (pch_data << i);
    }
    return 0;
}

```

```

int gpio_writepin (int pin_num, unsigned char value)
{
    unsigned char data;
    unsigned char tmp;

    switch (pin_num)
    {
        case 1:
            if( value )
            {
                tmp
                EC_GetRamByte(EC_PIN1_VALUE_ADDR);
                tmp |= EC_Bit0;
                EC_SetRamByte(EC_PIN1_VALUE_ADDR, tmp);
            }
            else
            {
                tmp
                EC_GetRamByte(EC_PIN1_VALUE_ADDR);
                tmp &= ~EC_Bit0;
                EC_SetRamByte(EC_PIN1_VALUE_ADDR, tmp);
            }
            break;
        case 2:
            if( value )
            {
                tmp
                EC_GetRamByte(EC_PIN2_VALUE_ADDR);
                tmp |= EC_Bit1;
                EC_SetRamByte(EC_PIN2_VALUE_ADDR, tmp);
            }
            else
            {
                tmp
                EC_GetRamByte(EC_PIN2_VALUE_ADDR);
                tmp &= ~EC_Bit1;
                EC_SetRamByte(EC_PIN2_VALUE_ADDR, tmp);
            }
            break;
        case 3:
            if( value )
            {

```

```

tmp = EC_GetRamByte(EC_PIN3_VALUE_ADDR);
tmp |= EC_Bit2;

EC_SetRamByte(EC_PIN3_VALUE_ADDR, tmp);
}

else
{
tmp = EC_GetRamByte(EC_PIN3_VALUE_ADDR);
tmp &= ~EC_Bit2;

EC_SetRamByte(EC_PIN3_VALUE_ADDR, tmp);
}

break;

case 4:
if( value )
{
tmp = EC_GetRamByte(EC_PIN4_VALUE_ADDR);
tmp |= EC_Bit3;

EC_SetRamByte(EC_PIN4_VALUE_ADDR, tmp);
}

else
{
tmp = EC_GetRamByte(EC_PIN4_VALUE_ADDR);
tmp &= ~EC_Bit3;

EC_SetRamByte(EC_PIN4_VALUE_ADDR, tmp);
}

break;

case 5:
if( value )
{
tmp = EC_GetRamByte(EC_PIN5_VALUE_ADDR);
//tmp |= EC_Bit4;
tmp &= ~EC_Bit4;

EC_SetRamByte(EC_PIN5_VALUE_ADDR, tmp);
}

else
{

```

```

tmp = EC_GetRamByte(EC_PIN5_VALUE_ADDR);
//tmp &= ~EC_Bit4;
tmp |= EC_Bit4;

EC_SetRamByte(EC_PIN5_VALUE_ADDR, tmp);
}

break;
case 6:
if( value )
{
tmp = EC_GetRamByte(EC_PIN6_VALUE_ADDR);
tmp &= ~EC_Bit5;

EC_SetRamByte(EC_PIN6_VALUE_ADDR, tmp);
}
else
{
tmp = EC_GetRamByte(EC_PIN6_VALUE_ADDR);
tmp |= EC_Bit5;

EC_SetRamByte(EC_PIN6_VALUE_ADDR, tmp);
}
break;
case 7:
if( value )
{
tmp = EC_GetRamByte(EC_PIN7_VALUE_ADDR);
tmp &= ~EC_Bit6;

EC_SetRamByte(EC_PIN7_VALUE_ADDR, tmp);
}
else
{
tmp = EC_GetRamByte(EC_PIN7_VALUE_ADDR);
tmp |= EC_Bit6;

EC_SetRamByte(EC_PIN7_VALUE_ADDR, tmp);
}
break;
case 8:
if( value )

```

```

        {
            tmp
            =
            EC_GetRamByte(EC_PIN8_VALUE_ADDR);
            tmp &= ~EC_Bit7;

            EC_SetRamByte(EC_PIN8_VALUE_ADDR, tmp);
        }
        else
        {
            tmp
            =
            EC_GetRamByte(EC_PIN8_VALUE_ADDR);
            tmp |= EC_Bit7;

            EC_SetRamByte(EC_PIN8_VALUE_ADDR, tmp);
        }
        break;
    default:
        printf("invalid pin number when writing to
gpio\n");
        return 1;
    }

    return 0;
}

int gpio_write (unsigned char value)
{
    unsigned char data;
    int i;

    for (i = 0; i < 8; i++)
        gpio_writepin (2, i+1, value & (0x01 << i));

    return 0;
}

int main(void)
{
    unsigned char gpio_dir;
    unsigned char gpio_value;
    int i;
    unsigned char gpio_pin, gpio_direction;
    unsigned char d2;

    printf("RUBY-D716VG2AR GPIO (EC line) TEST Program v1.0\n");
    printf("Please short the following pins with jumper on GPIO\n");
}

```

```
printf("PIN 1,2,3,4 is output ; PIN 5,6,7,8 is input\n");
printf("GPIO 1 ---> GPIO 5\n");
printf("GPIO 2 ---> GPIO 6\n");
printf("GPIO 3 ---> GPIO 7\n");
printf("GPIO 4 ---> GPIO 8\n");
printf("GND      xxxx VCC  <==PWR/GND pins, DO NOT short them!\n");
printf("Test Begins...\n");

gpio_setdirection (0xF0);
gpio_write (0x00);

gpio_readpin (5, &d2);
delay (2);
if (d2 == 0)
    printf ("GPIO 1->GPIO 5 test PASS !!! (pull low)\n");
else
    printf ("GPIO 1->GPIO 5 test FAIL !!! (pull high)\n");

gpio_readpin (6, &d2);
delay (2);
if (d2 == 0)
    printf ("GPIO 2->GPIO 6 test PASS !!! (pull low)\n");
else
    printf ("GPIO 2->GPIO 6 test FAIL !!! (pull high)\n");

gpio_readpin (7, &d2);
delay (2);
if (d2 == 0)
    printf ("GPIO 3->GPIO 7 test PASS !!! (pull low)\n");
else
    printf ("GPIO 3->GPIO 7 test FAIL !!! (pull high)\n");

gpio_readpin (8, &d2);
delay (2);
if (d2 == 0)
    printf ("GPIO 4->GPIO 8 test PASS !!! (pull low)\n");
else
    printf ("GPIO 4->GPIO 8 test FAIL !!! (pull high)\n");
return 0;
}
```

## Chapter 4

# BIOS Setup Information

RUBY-D716VG2ARVG2AR is equipped with the Phoenix BIOS stored in Flash ROM. These BIOS has a built-in Setup program that allows users to modify the basic system configuration easily. This type of information is stored in CMOS RAM so that it is retained during power-off periods. When system is turned on, RUBY-D716VG2ARVG2AR communicates with peripheral devices and checks its hardware resources against the configuration information stored in the CMOS memory. If any error is detected, or the CMOS parameters need to be initially defined, the diagnostic program will prompt the user to enter the SETUP program. Some errors are significant enough to abort the start up.

### 4.1 Entering Setup -- Launch System Setup

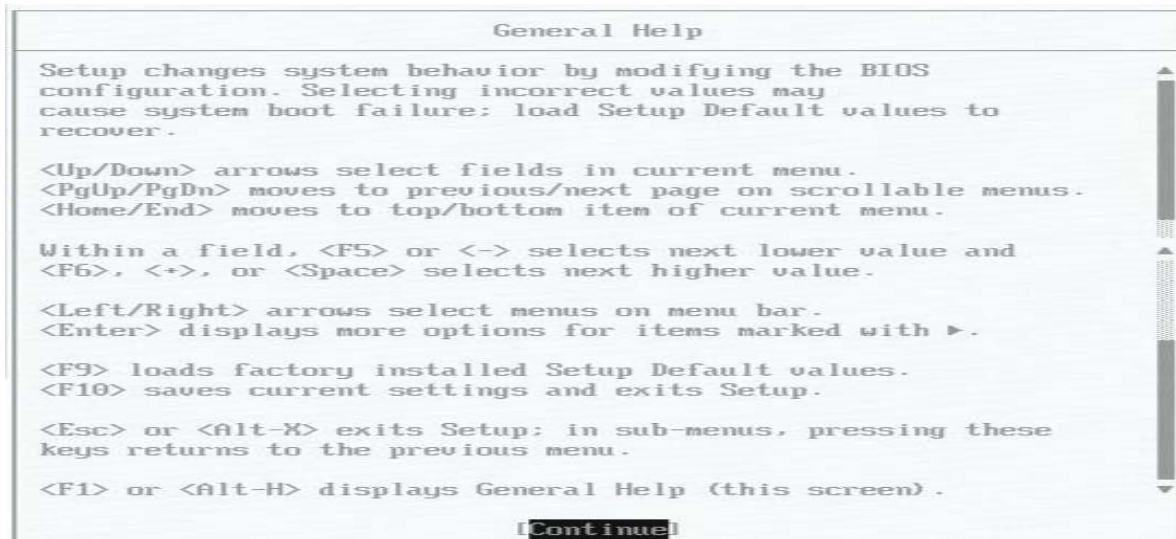
Power on the computer and the system will start POST (Power On Self Test) process. When the message below appears on the screen, press **<F2>** key will enter BIOS setup screen.

#### Press **<F2>** to enter SETUP

If the message disappears before responding and still wish to enter Setup, please restart the system by turning it OFF and On or pressing the RESET button. It can be also restarted by pressing **<Ctrl>**, **<Alt>**, and **<Delete>** keys on keyboard simultaneously.

#### Press **<F1>** to Run General Help or Resume

The BIOS setup program provides a General Help screen. The menu can be easily called up from any menu by pressing **<F1>**. The Help screen lists all the possible keys to use and the selections for the highlighted item. Press **<Esc>** to exit the Help Screen.



## 4.2 Main

Use this menu for basic system configurations, such as time, date etc.



### System Date

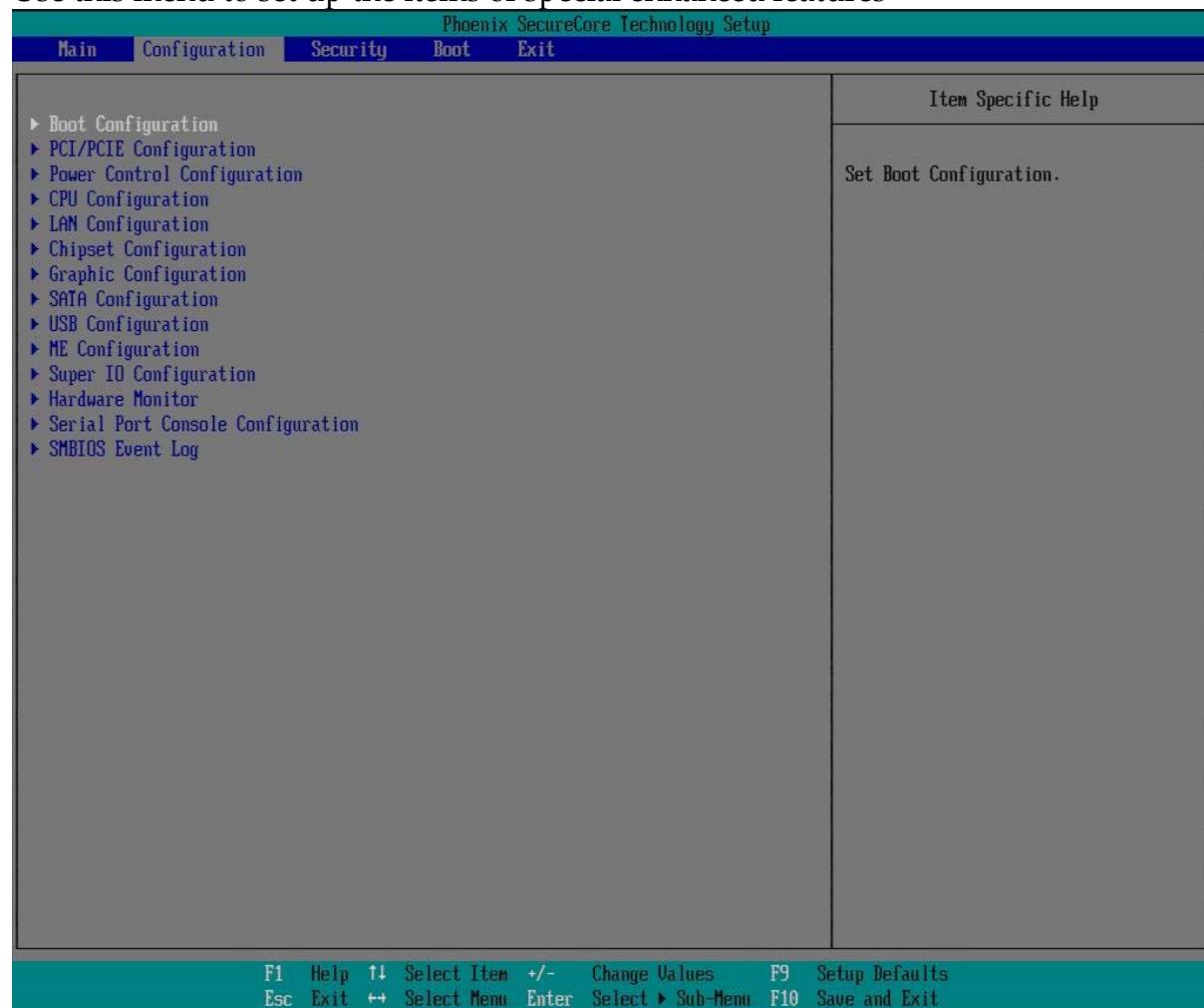
The date format is <Day>, <Month> <Date> <Year>. Use [+] or [-] to configure system Date.

### System Time

The time format is <Hour> <Minute> <Second>. Use [+] or [-] to configure system Time.

## 4.3 Configuration

Use this menu to set up the items of special enhanced features



**Boot Configuration**

Set Boot Configuration.

Phoenix SecureCore Technology Setup		
Configuration	Boot Configuration	Item Specific Help
NumLock:	<b>ON</b>	Selects Power-on state for NumLock.
Quick Boot	[Disabled]	
Diagnostic Splash Screen	[Disabled]	
Diagnostic Summary Screen	[Disabled]	
Allow Hotkey in S4 resume	[Disabled]	
UEFI Boot	[Enabled]	

F1 Help  $\uparrow\downarrow$  Select Item  $+/ -$  Change Values F9 Setup Defaults  
 Esc Exit  $\leftrightarrow$  Select Menu Enter Select  $\blacktriangleright$  Sub-Menu F10 Save and Exit

**NumLock:**

Selects Power-on state for NumLock.

Choices: OFF, ON.

**Quick Boot**

Enable/Disable quick boot.

Choices: Disabled, Enabled.

**Diagnostic Splash Screen**

If you select 'Enabled' the diagnostic splash screen always displays during boot. If you select 'Disabled' the diagnostic splash screen does not displays unless you press HOTKEY during boot.

Choices: Disabled, Enabled.

**Diagnostic Summary Screen**

Display the Diagnostic summary screen during boot.

Choices: Disabled, Enabled.

**Allow Hotkey in S4 resume**

Enable hotkey detection when system resuming from Hibernate state.

Choices: Disabled, Enabled.

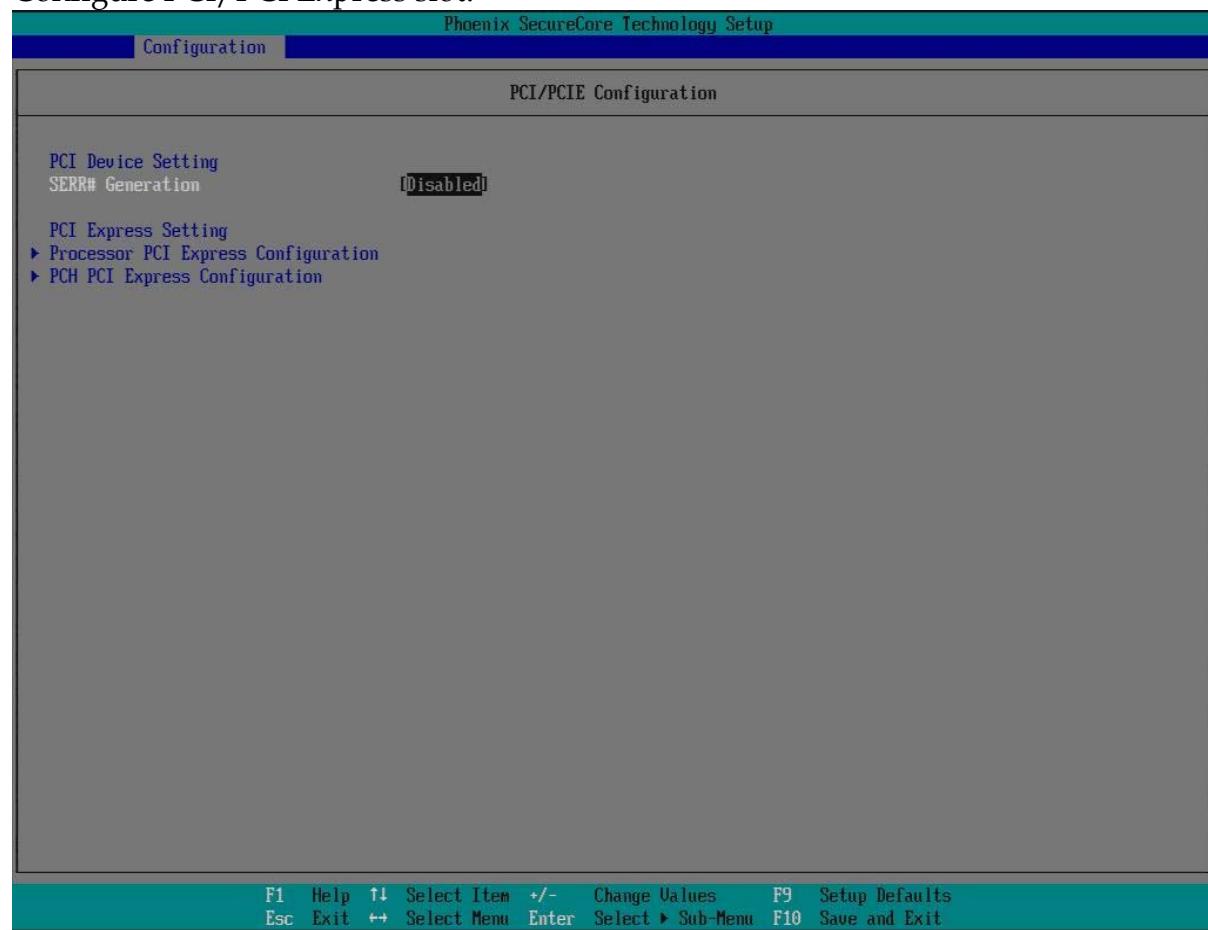
**UEFI Boot**

Enable the UEFI boot.

Choices: Disabled, Enabled.

**PCI/PCIE Configuration**

Configure PCI/PCI Express slot.



## Processor PCI Express Configuration

Processor PCI Express Configuration		Item Specific Help
PEG0 PEG0 - Gen X [Gen2] PEG1 PEG1 - Gen X [Gen2] PEG2 PEG2 - Gen X [Gen2]  De-emphasis Control [-6 dB]		Configure PEG0 B0:D1:F0 Speed.

### FEG0 PEG0 - Gen X

Configure PFG0 B0:D0:F0 Speed.

Choices: Gen1, Gen2, Gen3

### FEG1 PEG1 - Gen X

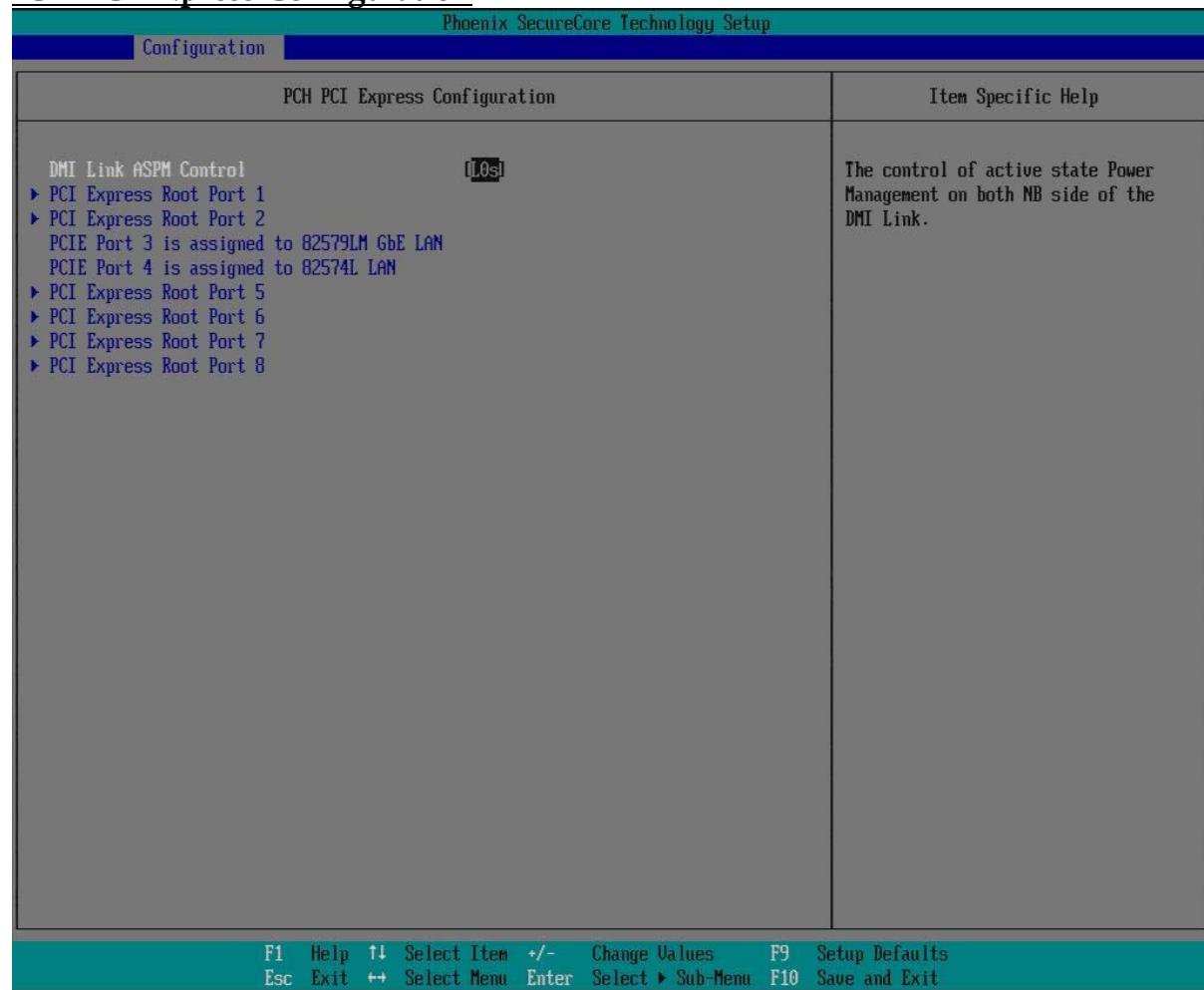
Configure PFG1 B0:D0:F1 Speed.

Choices: Gen1, Gen2, Gen3

### FEG2 PEG2 - Gen X

Configure PFG2 B0:D0:F2 Speed.

Choices: Gen1, Gen2, Gen3

**ICH PCI Express Configuration****DMI Link ASPM Control**

The control of active state Power Management on both NB side of the DMI Link.  
 Choices: Disabled, L0s, L1, L0sL1.

**PCI Express Root Port 1, 5-8**

Control PCI Express root port.

Phoenix SecureCore Technology Setup		
Configuration	PCI Express Root Port 1	Item Specific Help
PCI Express Root Port 1: <input checked="" type="checkbox"/> Enabled PCIe Speed: <input type="checkbox"/> Gen1 <input checked="" type="checkbox"/> Disabled ASPM: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled HOT PLUG: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled URR: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled FER: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled NFER: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled CER: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled SEFE: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled SENFE: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled SECE: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled PME Interrupt: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Disabled PME SCI: <input type="checkbox"/> Enabled <input checked="" type="checkbox"/> Enabled	Control PCI Express root port.	
F1 Help <input type="checkbox"/> Select Item <input type="checkbox"/> Change Values F9 Setup Defaults Esc Exit <input type="checkbox"/> Select Menu <input type="checkbox"/> Enter Select <input type="checkbox"/> Sub-Menu F10 Save and Exit		

**PCI Express Root Port 1, 5-8**

Control PCI Express root port.

Choices: Disabled, Enabled.

**PCIe Speed**

Select PCIe Speed to Gen1 or Gen2

Choices: Auto, Gen1, Gen2.

**ASPM**

Control PCIe Active State Power Management settings.

Choices: Disabled, L0S, L1, L0S And L1, Auto.

**HOT PLUG**

PCI Express Hot Plug Enabled/Disabled.

Choices: Disabled, Enabled.

**URR**

PCI Express Unsupported Request Reporting Enable/Disable.

Choices: Disabled, Enabled.

**FER**

PCI Express Device Fatal Error Reporting Enable/Disable.

Choices: Disabled, Enabled.

**NFER**

PCI Express Device Non-Fatal Error Reporting Enable/Disable.

Choices: Disabled, Enabled.

**CER**

PCI Express Device Correctable Error Reporting Enable/Disable.

Choices: Disabled, Enabled.

**SEFE**

Root PCI Express System Error on Fatal Error Enable/Disable.

Choices: Disabled, Enabled.

**SENFE**

Root PCI Express System Error on Non-Fatal Error Enable/Disable.

Choices: Disabled, Enabled.

**SECE**

Root PCI Express System Error on Correctable Error Enable/Disable.

Choices: Disabled, Enabled.

**PME Interrupt**

Root PCI Express PME Interrupt Enable/Disable.

Choices: Disabled, Enabled.

**PME SCI**

PCI Express PME SCI

Choices: Disabled, Enabled.

**Power Control Configuration**

Configure ACPI and RTC wake up setting.

Phoenix SecureCore Technology Setup															
Configuration															
<table border="1"> <thead> <tr> <th colspan="2">Power Control Configuration</th> </tr> </thead> <tbody> <tr> <td>Restore AC power loss</td><td>[Power Off]</td></tr> <tr> <td>SLP_S4 Assertion stretch Enable</td><td>[Disabled]</td></tr> <tr> <td>Wake system with Fixed Time</td><td>[Disabled]</td></tr> <tr> <td>Wake up By PS/2 Keyboard</td><td>[Disabled]</td></tr> <tr> <td>Wake up By PS/2 Mouse</td><td>[Disabled]</td></tr> <tr> <td>Wake up By Ring</td><td>[Disabled]</td></tr> </tbody> </table>	Power Control Configuration		Restore AC power loss	[Power Off]	SLP_S4 Assertion stretch Enable	[Disabled]	Wake system with Fixed Time	[Disabled]	Wake up By PS/2 Keyboard	[Disabled]	Wake up By PS/2 Mouse	[Disabled]	Wake up By Ring	[Disabled]	Item Specific Help
Power Control Configuration															
Restore AC power loss	[Power Off]														
SLP_S4 Assertion stretch Enable	[Disabled]														
Wake system with Fixed Time	[Disabled]														
Wake up By PS/2 Keyboard	[Disabled]														
Wake up By PS/2 Mouse	[Disabled]														
Wake up By Ring	[Disabled]														

F1 Help F11 Select Item +/- Change Values F9 Setup Defaults  
 Esc Exit F12 Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit

**Restore AC Power Loss**

Select AC Power state when power is re-applied after a power failure.

Choices: Power Off, Power On, Last State.

**SLP\_S4 Assertion stretch Enable**

Choices: Disabled, Enabled

**Wake system with Fixed Time**

Enable or disable system wake on alarm event. When Enabled, system will wake on the hr::min::sec specified.

Choices: Disabled, Enabled

**Wake up By PS/2 Keyboard**

Choices: Enabled, Disabled.

**Wake up By PS/2 Mouse**

Choices: Enabled, Disabled.

**Wake up By Ring**

Choices: Enabled, Disabled.

**CPU configuration**

Configure the specific active core(s) and advanced processor management technologies.

Phoenix SecureCore Technology Setup		
Configuration		
CPU Configuration		Item Specific Help
Max Processor Speed	2.600 GHz	
Processor Cores	[4]	
Intel HT technology	Supported	
Hyper-threading	[Enabled]	Enabled for windows XP and Linux (OS optimized for Hyper-threading Technology) and Disabled for other OS (OS not optimized for Hyper-Threading). When Disabled only one.
Active Processor Cores	[All]	
Limit CPUID Maximum	[Disabled]	
Execute Disable Bit	[Enabled]	
EIST	[Enabled]	
Turbo Mode	[Disabled]	
C-States	[Disabled]	
VT-x	[Enabled]	
Local x2APIC	[Disabled]	

F1 Help  $\uparrow\downarrow$  Select Item  $+/ -$  Change Values F9 Setup Defaults  
 Esc Exit  $\leftrightarrow$  Select Menu Enter Select  $\blacktriangleright$  Sub-Menu F10 Save and Exit

**Hyper-Threading**

Enabled for Windows XP and Linux (OS optimized for Hyper-Threading Technology) and Disabled for other OS (OS not optimized for Hyper-Threading Technology). When Disabled only one.

Choices: Disabled, Enabled.

**Active Processor Cores**

Select the number of physical cores to enable in each processor package.

Choices: All, 1.

**Limit CPUID Maximum**

Disabled for Windows XP.

Choices: Disabled, Enabled.

**Execute Disabled Bit**

Enabled Execute Disabled functionality. Also known as Data Execution Prevention (DEP).

Choices: Disabled, Enabled.

**EIST**

Choices: Disabled, Enabled.

**Turbo Mode**

Choices: Disabled, Enabled.

**C-States**

Choices: Disabled, Enabled.

**VT-x**

When enabled, a VWM can utilize the additional hardware capabilities provided by Vanderpool Technology.

Choices: Disabled, Enabled.

**Local x2APIC**

Choices: Disabled, Enabled.

**LAN Configuration**

Configure onboard LAN device.

LAN Configuration		Item Specific Help
Intel WGI217-LM GbE LAN Wake on LAN LAN Boot ROM	[Enabled] [Enabled] [Enabled]	Enabled/Disabled Intel WGI217-LM GbE LAN.

F1 Help ↑ Select Item +/- Change Values F9 Setup Defaults  
Esc Exit ← Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit

**Intel WG1217-LM GbE LAN**

Enabled/Disabled Intel WG1217-LM GbE LAN.

Choices: Disabled, Enabled.

**Wake on LAN**

Enabled/Disabled Wake on LAN Function.

Choices: Disabled, Enabled.

**LAN Boot ROM**

Control LAN Boot ROM (PXE) function.

Choices: Disabled, Enabled.

**LAN4**

Enabled/Disabled LAN4.

Choices: Disabled, Enabled.

**Wake on LAN**

Enabled/Disabled Wake on LAN Function.

Choices: Disabled, Enabled.

**Chipset Configuration**

Configure Chipset provide feature.

Chipset Configuration		Item Specific Help
UT-d <input checked="" type="checkbox"/> NB PCIe Configuration <input checked="" type="checkbox"/> Memory Configuration <input checked="" type="checkbox"/> SB Azalia Config	<input checked="" type="checkbox"/> Disabled	Check to enable UT-d function on MCH.

F1 Help   F2 Select Item   F3 Change Values   F9 Setup Defaults  
Esc Exit   F4 Select Menu   Enter Select   F10 Save and Exit

**VT-d**

Check to enable VT-d function on MCH.  
Choices: Disabled, Enabled.

**NB PCIe Configuration**

Config NB PCI Express Settings.

NB PCIe Configuration		Item Specific Help
Always Enable PEG [Enabled] PEG ASPM [Disabled]		To Enable the PEG Slot.

F1 Help **↑** Select Item **+/ -** Change Values F9 Setup Defaults  
Esc Exit **↔** Select Menu Enter Select **▶** Sub-Menu F10 Save and Exit

**Always Enable PEG**

To Enable the PEG Slot.  
Choices: Disabled, Enabled.

**PEG ASPM**

Control ASPM Support for the PEG Device. This has no effect if PEF is not the current active service.  
Choices: Disabled, Auto, ASPM L0s, ASPM L1, ASPM L0sL1.

## Memory Configuration

### Memory Configuration Parameters.

Phoenix SecureCore Technology Setup	
Configuration	Memory Configuration
Memory Frequency 1333 MHz	Item Specific Help
DIMM#0	Maximum Value of TOLUD. Dynamic assignment would adjust TOLUD automatically based on largest MMIO length of installed graphic controller.
DIMM#1	
DIMM#2	
DIMM#3 2048 MB (DDR3)	
Max TOLUD 12 GB	
Memory Frequency [Auto]	

F1 Help  $\uparrow\downarrow$  Select Item  $+/ -$  Change Values F9 Setup Defaults  
 Esc Exit  $\leftrightarrow$  Select Menu Enter Select  $\triangleright$  Sub-Menu F10 Save and Exit

### Max TOLUD

Maximum Value of TOLUD. Dynamic assignment would adjust TOLUD automatically based on largest MMIO length of installed graphic controller.

Choices: 1GB, 1.25GB, 1.5GB, 1.75GB, 2GB, 2.25GB, 2.5GB, 2.75GB, 3GB, 3.25GB.

### Memory Frequency

Maximum Memory Frequency Selections in Mhz.

Choices: Auto, 1067, 1333, 1600, 1867, 2133.

## SB Azalia Config

### SB Azalia Config Parameters.

Phoenix SecureCore Technology Setup	
Configuration	SB Azalia Configuration
	Item Specific Help
Azalia [Enabled]	Control Detection of the Azalia device.
<b>F1 Help</b> <b>↑↓</b> Select Item <b>+/-</b> Change Values <b>F9 Setup Defaults</b> <b>Esc</b> Exit <b>↔</b> Select Menu <b>Enter</b> Select <b>▶</b> Sub-Menu <b>F10 Save and Exit</b>	

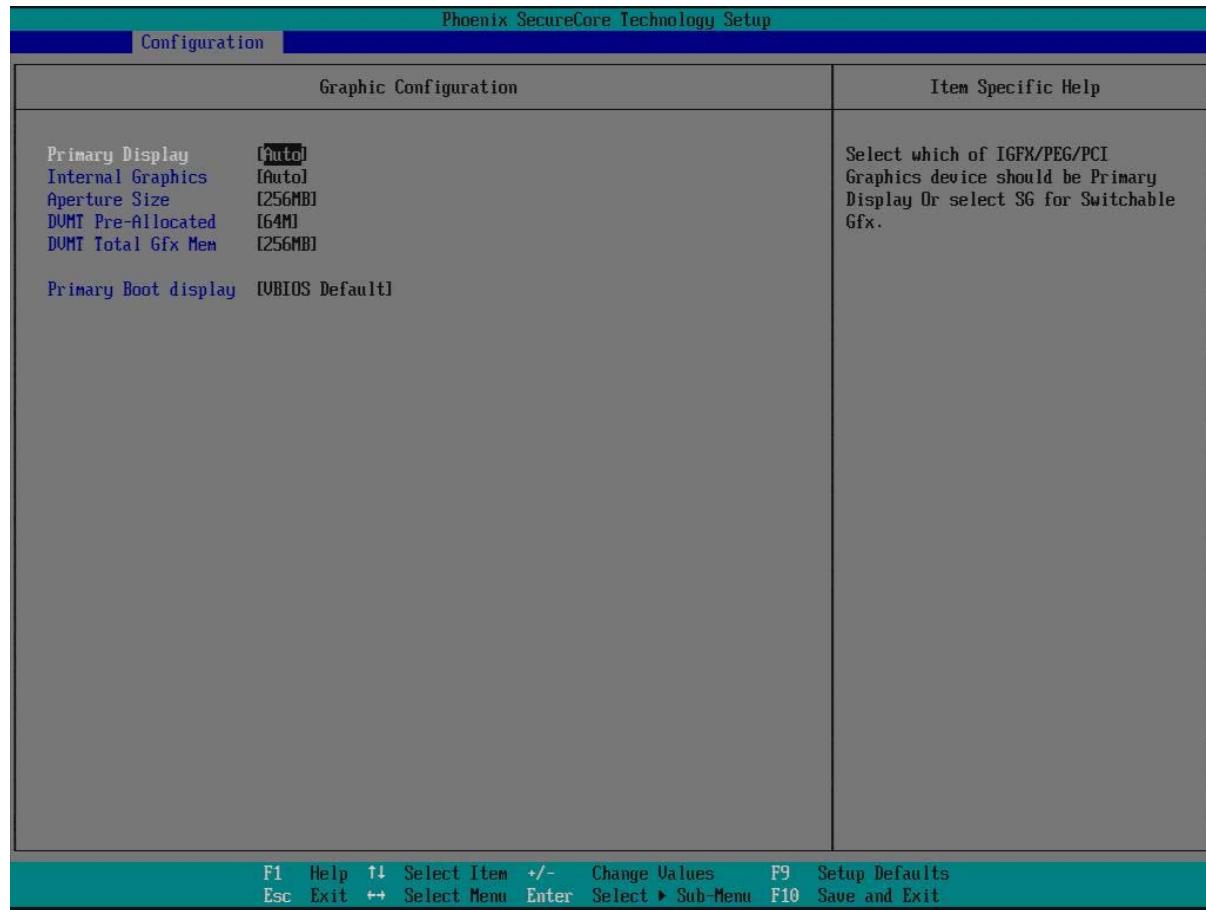
#### Azalia

Control Detection of the Azalia device.

Choices: Disabled, Enabled.

## Graphic Configuration

Configure integrated Graphic like Boot display, video memory and external Graphic feature.



### Primary Display

Select which of IGFX/PEG/PCI Graphics device should be Primary Display Or select SG for Switchable Gfx.

Choices: Auto, IGFX, PEG.

### Internal Graphics

Keep IGD Enabled Based on the setup options,

Choices: Auto, Disabled, Enabled.

### Aperture Size

Select the Aperture Size

Choices: 128MB, 256MB, 512MB.

### DVMT Pre-Allocated

Select DVMT 5.0 Pre-Allocated Graphics Memory size used by the Internal Graphics Device.

Choices: 0M, 32M, 64M, 96M, 128M, 160M, 192M, 224M, 256M, 288M, 320M, 352M, 384M, 416M, 448M, 480M, 512M.

**DVMT Total Gfx Mem**

Select DVMT 5.0 Total Graphics Memory size used by the Internal Graphics Device.  
Choices: 128MB, 256MB, MAX.

**Primay Boot display**

Choices: VBIOS Default, CRT, DVI, HDMI.

**SATA Configuration**

Configure SATA controller and view detected HDD Information.

SATA Configuration		Item Specific Help
SATA Controller(s)	[Enabled]	▲ Enable/Disable SATA Device.
Launch Storage OpROM	[Disabled]	
SATA Mode	[AHCI]	
Serial ATA Port 0	[Empty]	]
Port 0	[Enabled]	
Hot Plug	[Enabled]	
External Port	[Disabled]	
SATA Device Type	[Hard Disk Driver]	
Serial ATA Port 1	[Empty]	]
Port 1	[Enabled]	
Hot Plug	[Enabled]	
External Port	[Disabled]	
SATA Device Type	[Hard Disk Driver]	
Serial ATA Port 2	[Empty]	]
Port 2	[Enabled]	
Hot Plug	[Enabled]	
External Port	[Disabled]	
Serial ATA Port 3	[Empty]	]
Port 3	[Enabled]	
Hot Plug	[Enabled]	
External Port	[Disabled]	
Serial ATA Port 4	[Empty]	]
Hard disk 4	[Empty]	]
Port 4	[Enabled]	
Hot Plug	[Enabled]	
External Port	[Disabled]	
Serial ATA Port 5	[Empty]	]
Hard disk 5	[Empty]	]
Port 5	[Enabled]	

F1 Help    F9 Setup Defaults  
Esc Exit    F10 Save and Exit  
F2 Select Item    F3 Change Values  
F4 Select Menu    F5 Sub-Menu  
F6 Enter    F7 Select

**SATA Controller (s)**

Determines how SATA controllers (s) operate.

Choices: Disabled, Enabled.

**Launch Storage OpROM**

Enable or Disable Boot Option for Legacy Mass Storage Devices with Option ROM.

Choices: Enabled, Disabled.

**SATA Mode**

Determines how SATA controllers (s) operate.

Choices: Disabled, IDE, AHCI, RAID.

**Serial ATA Port 0-5**

Display the identity of the device attached.

Choices: Empty.

**Port 0-5**

Enabled or Disabled SATA Port.

Choices: Disabled, Enabled.

**Hot Plug**

Designates this port as Hot Pluggable.

Choices: Disabled, Enabled.

**External Port**

External SATA Support.

Choices: Disabled, Enabled.

**SATA Device Type**

Select "Solid State Drive" only if a Solid State Drive is connected to this SATA port.

Choices: Hard Disk Driver, Solid State Driver.

**USB Configuration**

Configure USB controller and other advanced setting.

USB Configuration		Item Specific Help
Legacy USB Support <b>Enabled</b> ▶ PCH USB Configuration		Enables Legacy USB support. AUTO option disables legacy support if no USB devices are connected. DISABLE option will keep USB devices available only for EFI applications.

### Legacy USB Support

Enables Legacy USB support. AUTO option disables legacy support if no USB devices are connected. DISABLE option will keep USB devices available only for EFI applications.

Choices: Enabled, Disabled.

### PCH USB Configuration

Control each of the USB ports disabling.

Phoenix SecureCore Technology Setup	
Configuration	
PCH USB Configuration	Item Specific Help
USB Ports Per-Port Disable <b>Disabled</b>	Control each of the USB ports disabling.
<b>F1 Help</b> <b>↑↓</b> <b>Select Item</b> <b>+/-</b> <b>Change Values</b> <b>F9 Setup Defaults</b> <b>Esc Exit</b> <b>↔</b> <b>Select Menu</b> <b>Enter</b> <b>Select ▶ Sub-Menu</b> <b>F10 Save and Exit</b>	

### USB Ports Per-Port Disable

Choices: Enabled, Disabled.

## ME Configuration

Configure Management Engine Technology Parameters.

ME Configuration		Item Specific Help
ME FW Version 9.0.1.1333 ME Firmware Intel(R)ME SMB firmware Intel(R) ME [Enabled] fTPM Switch Selection [GPDMA Work-Around]		Enable/Disable Intel(R) Management Engine.

### Intel (R) ME

Enable/Disable Intel (R) Management Engine.

Choices: Enabled, Disabled.

### fTPM Switch Selection

Selects the desired fTPM solution to be used.

Choices: GPDMA Work-Around, MSFT QFE Solution.

**Super IO Configuration**

Configure LPC Super IO.

SIO Configuration		Item Specific Help
<b>Serial Port</b>		
Serial Port 1	[2E8 / IRQ4]	
Serial Port 2	[2F8 / IRQ3]	
Serial Port 3	[4E0 / IRQ10]	
Serial Port 4	[4E8 / IRQ10]	
Serial Port 5	[4F0 / IRQ10]	
Serial Port 6	[4F8 / IRQ10]	
Serial Port 7	[3E0 / IRQ11]	
Serial Port 8	[3E8 / IRQ11]	
Serial Port 9	[3F0 / IRQ11]	
Serial Port 10	[3F8 / IRQ11]	
<b>Serial Port</b> <b>COM2 Configuration</b>		[RS-232]
<b>Watch Dog Timer</b>		
Watch Dog Timer Select		[Disabled]
F1 Help <b>↑↓</b> Select Item <b>+/-</b> Change Values F9 Setup Defaults Esc Exit <b>↔</b> Select Menu Enter Select ► Sub-Menu F10 Save and Exit		

**Serial Port 1-10**

Choices: Disabled, 2E8/IRQ4, 2F8/IRQ3, 4E0/IRQ10, 4E8/IRQ10, 4F0/IRQ10, 4F8/IRQ10, 3E0/IRQ11, 3E8/IRQ11, 3F0/IRQ11, 3F8/IRQ11

**COM2 Configuration**

Select Com2 Configuration.

Choices: RS-232, RS422, RS485.

**Watch Dog Timer Select**

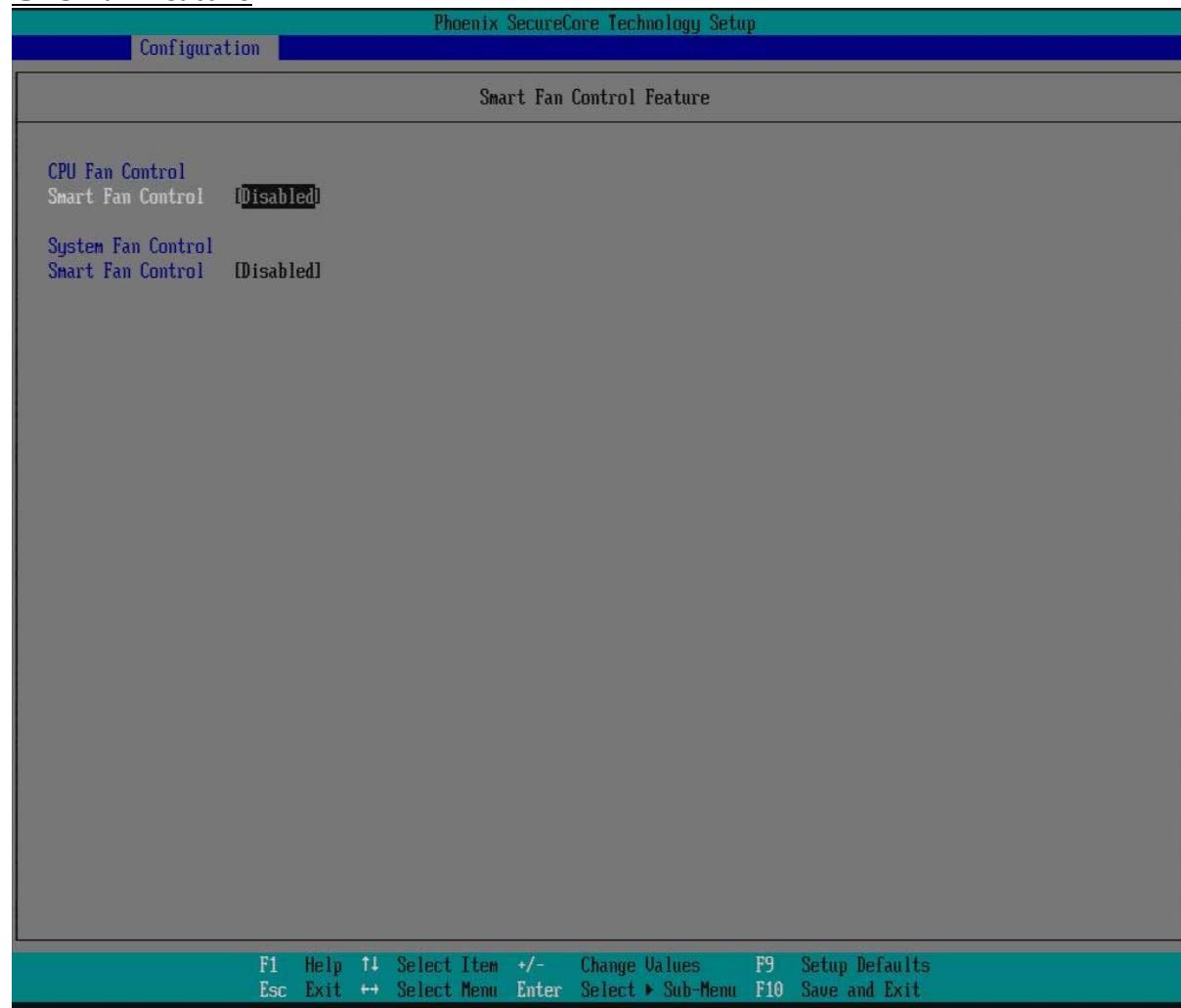
Choices: Disabled, 15 secs, 30 secs, 1 min, 2 mins, 3 mins.

## Hardware Monitor

Provide on board sensor reading information. (Show only)



## CPU Fan Feature



## CPU/System Fan Control

### Smart Fan Control

Choices: Enabled, Disabled.

## Serial Port Console Configuration

Configure console redirection on serial port.

Phoenix SecureCore Technology Setup	
Configuration	Item Specific Help
Serial Port Console Configuration Serial Port 1 Console Redirection <b>Disabled</b>	Control Console Redirection enable/disable.
<b>F1 Help</b> <b>↑</b> <b>Select Item</b> <b>+/-</b> <b>Change Values</b> <b>F9 Setup Defaults</b> <b>Esc</b> <b>Exit</b> <b>↔</b> <b>Select Menu</b> <b>Enter</b> <b>Select</b> <b>▶ Sub-Menu</b> <b>F10 Save and Exit</b>	

### Console Redirection

Control Console Redirection enable/disable.

Choices: Enabled, Disabled

**SMBIOS Event Log**

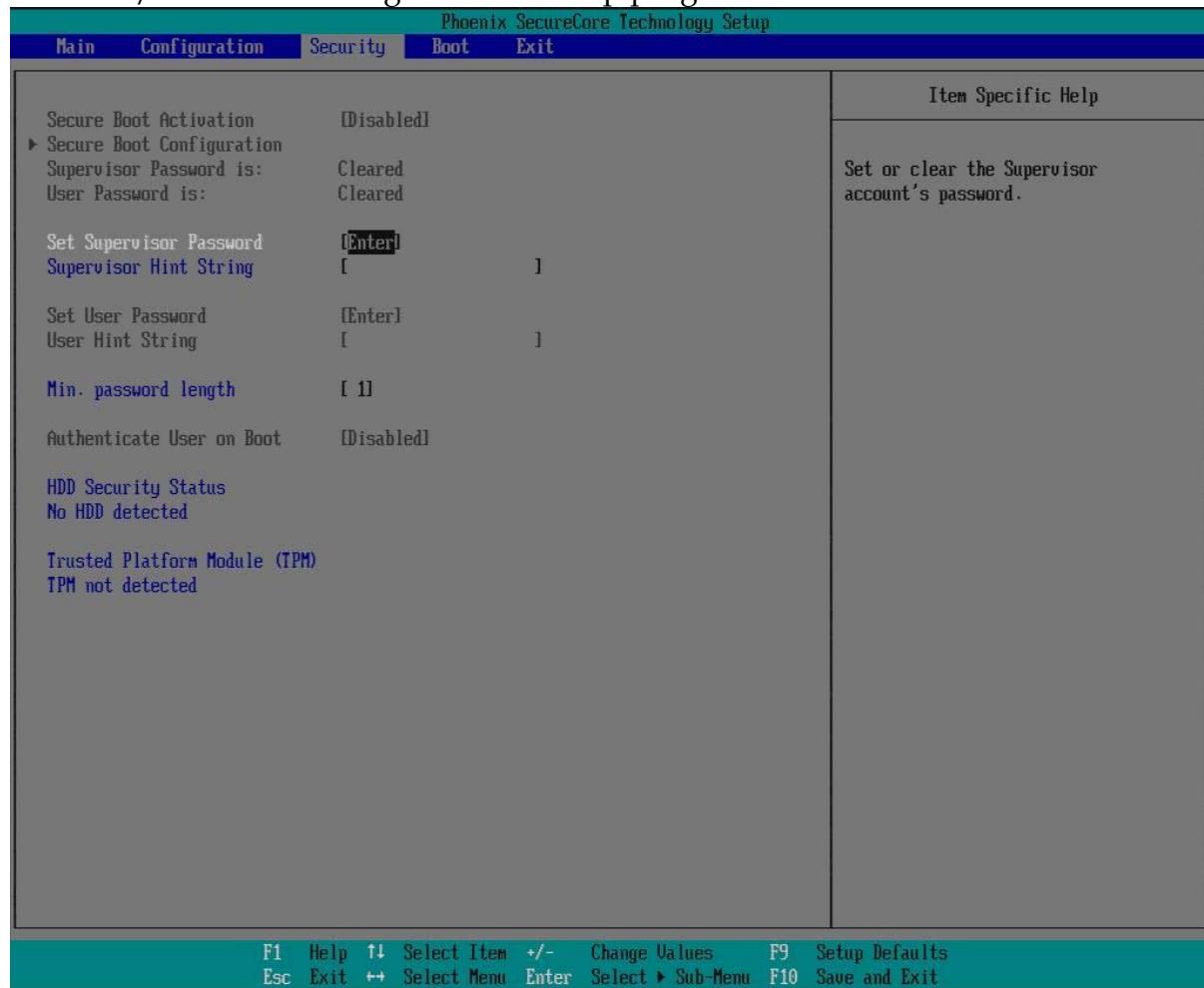
Phoenix SecureCore Technology Setup	
Configuration	
SMBIOS Event Log	Item Specific Help
Clears SMBIOS events [Enter] ▶ View SMBIOS event log	Clears SMBIOS events.
<b>F1 Help</b> <b>↑↓</b> Select Item <b>+/−</b> Change Values <b>F9 Setup Defaults</b> <b>Esc</b> Exit <b>↔</b> Select Menu <b>Enter</b> Select <b>▶ Sub-Menu</b> <b>F10 Save and Exit</b>	

**Clears SMBIOS events.**

Choices: Enter

## 4.4 Security

This section lets you set security passwords to control access to the system at boot time and/or when entering the BIOS setup program.



### Set Supervisor Password

Set or clear the Supervisor account's password.

### Supervisor Hint String

Press Enter to type Supervisor Hint String.

### Set User Password

Set or clear the User account' password.

### Supervisor Hint String

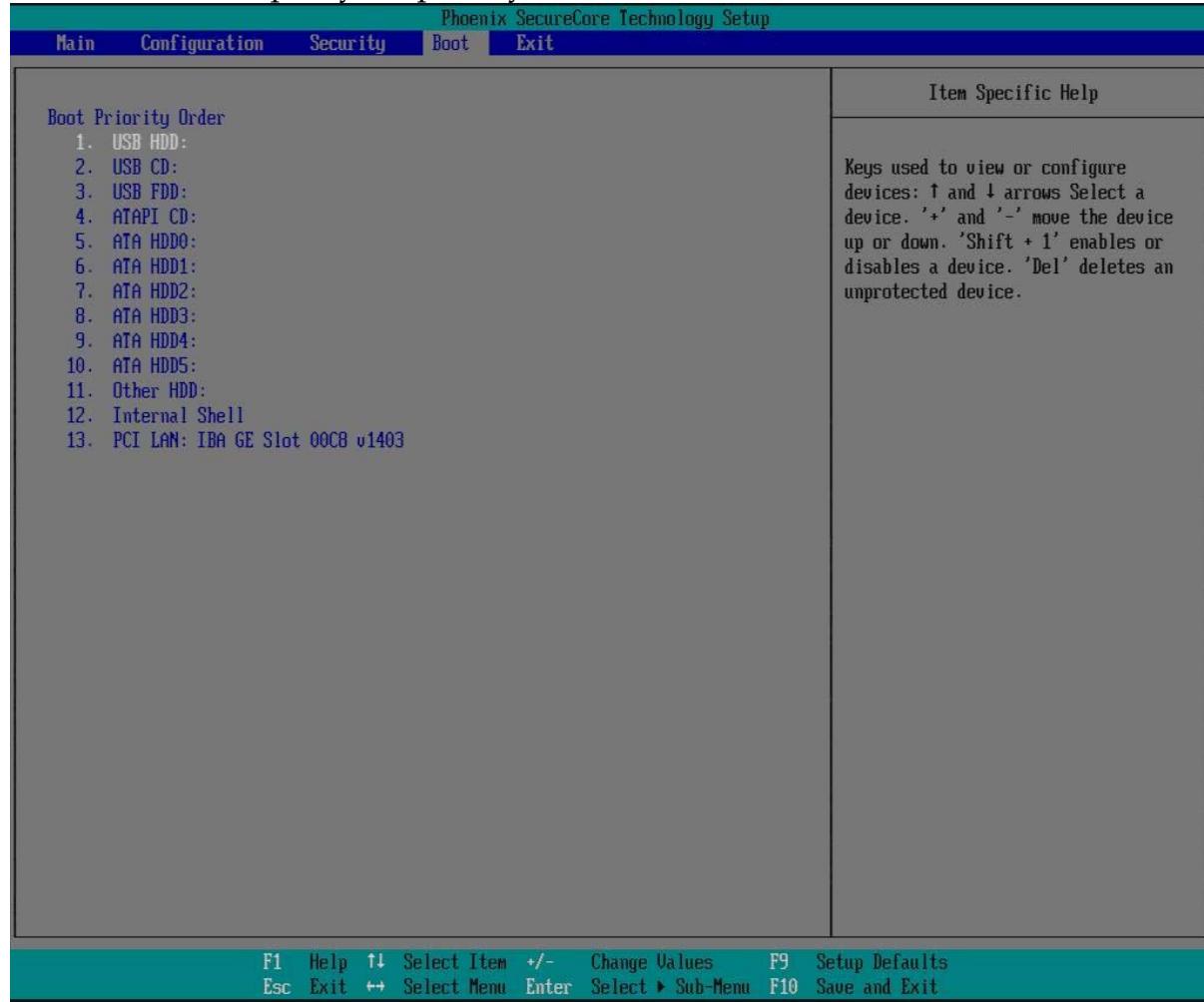
Press Enter to type User Hint String.

### Min. password length

Set the minimum number of characters for password (1-20).

## 4.5 Boot

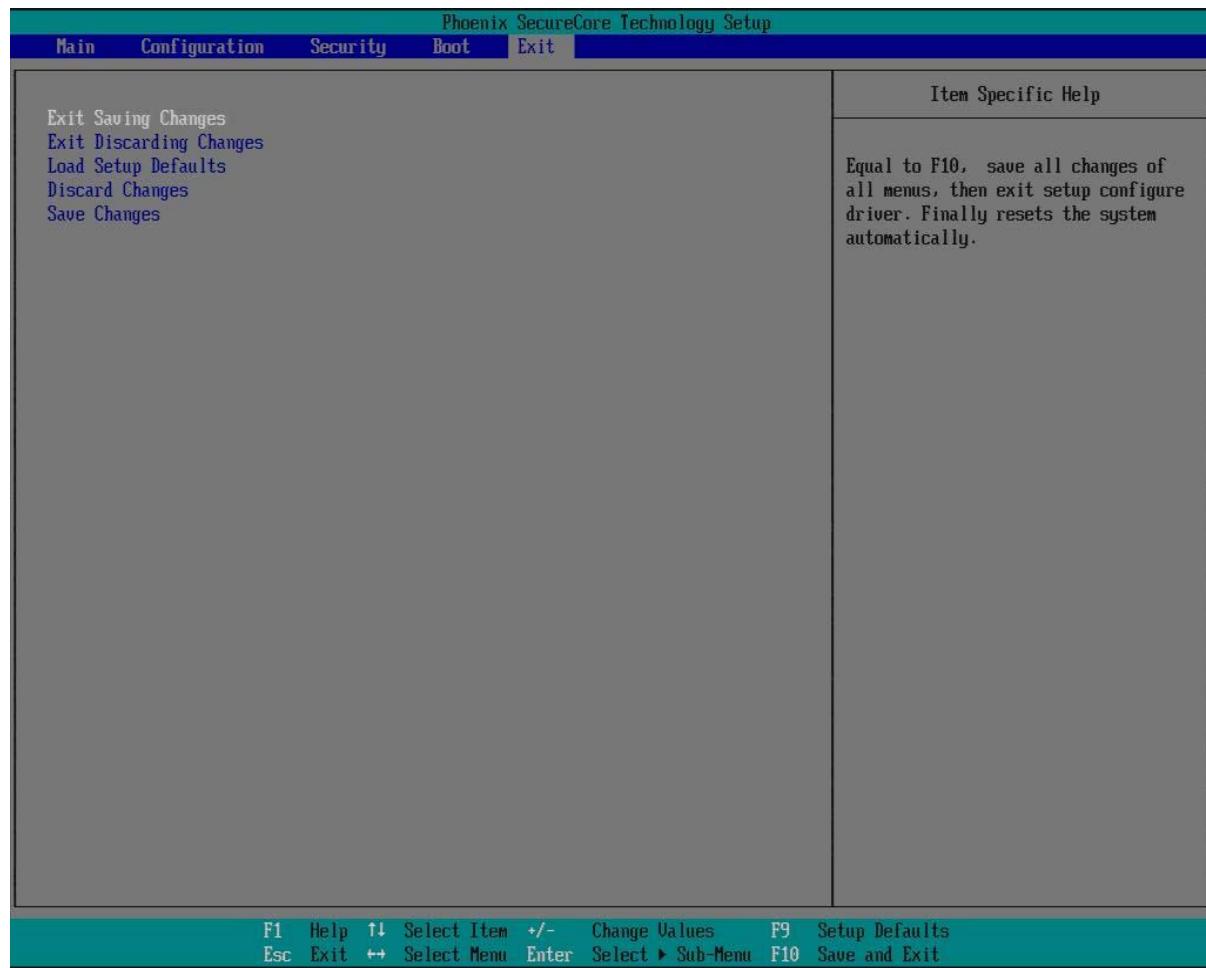
Use this menu to specify the priority of boot devices.



### Boot Priority Order

Keys used to view or configure devices: ↑ and ↓ arrows Select a device. '+' and '-' move the device up or down. 'Shift + 1' enables or disables a device. 'Del' deletes an unprotected device.

## 4.6 Exit



### Exit Saving Changes

Equal to F10, save all changes of all menus, then exit setup configure driver. Finally resets the system automatically.

### Exit Discarding Changes

Equal to ESC, never save changes, then exit setup configure driver.

### Load Setup Defaults

Equal to F9. Load standard default values.

### Load Optimized Defaults

Load settings for optimized boot time and system performance.

### Discard Changes

Load the original value of this boot time. Not the default Setup value.

### Save Changes

Save all changes of all menus, but do not reset sys

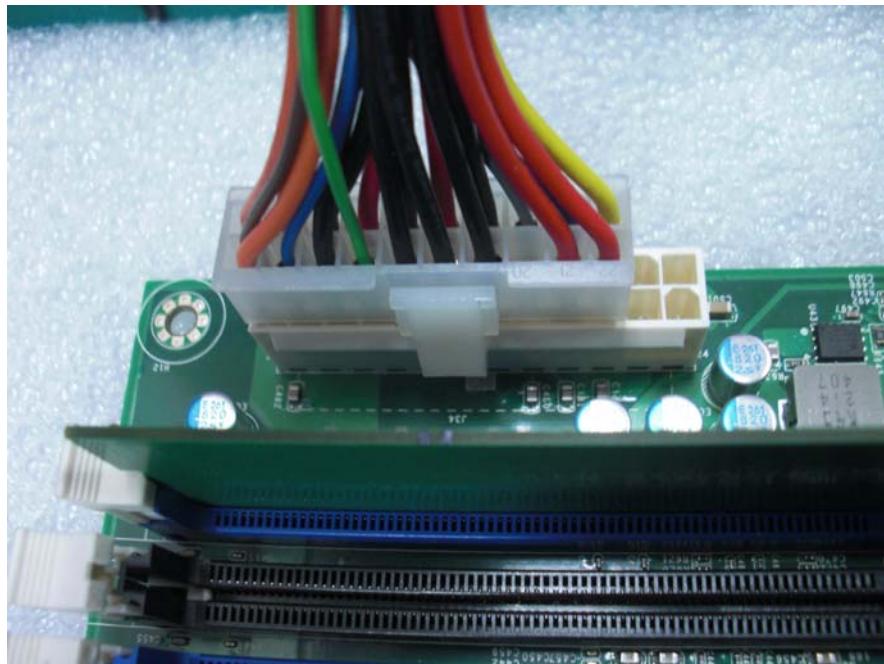
## Chapter 5

### Troubleshooting

This chapter provides a few useful tips to quickly get RUBY-D716VG2ARVG2AR running with success. As basic hardware installation has been addressed in Chapter 2, this chapter will focus on system integration issues, in terms of BIOS setting, and OS diagnostics.

#### 5.1      **Hardware Quick Installation**

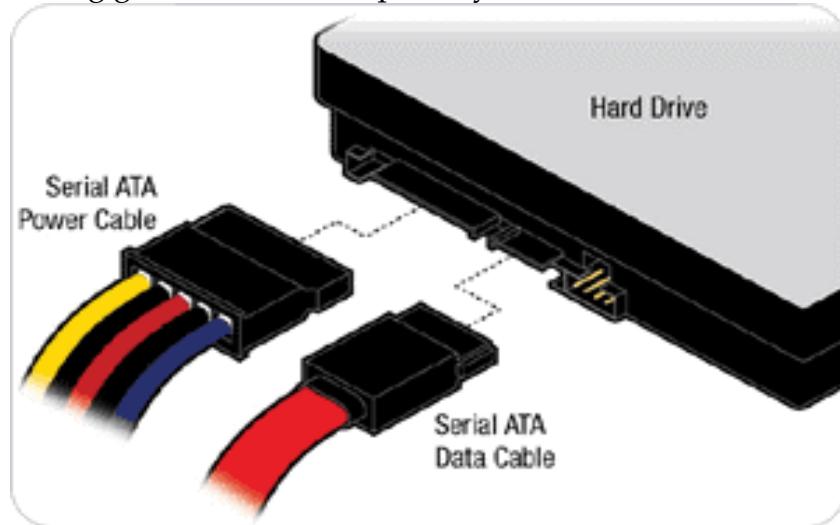
##### ATX Power Setting



RUBY-D716VG2AR supports ATX. Therefore, there is no other setting that really needs to be set up. However, there are only two connectors that must be connected—J7 (4 pins CPU +12V main power connector) & J35 (24 pins ATX Power Connector)

### Serial ATA Hard Disk Setting for IDE/RAID/AHCI

Unlike IDE bus, each Serial ATA channel can only connect to one SATA hard disk at a time; there are total six connectors, SATA1~6 port. The installation of Serial ATA is simpler and easier than IDE, because SATA hard disk doesn't require setting up Master and Slave, which can reduce mistake of hardware installation. All you need to operate IDE, RAID (0/1/5/10) and AHCI application for system, please follow up setting guide in BIOS setup utility



## 5.2 BIOS Setting

It is assumed that users have correctly adopted modules and connected all the devices cables required before turning on ATX power. CPU, CPU Fan, 204-pin DDR3 memory, keyboard, mouse, floppy drive, SATA hard disk, DVI-I connector, but it only can use on DVI-D function, doesn't support DVI-I function, device power cables,

ATX accessories are good examples that deserve attention. With no assurance of properly and correctly accommodating these modules and devices, it is very possible to encounter system failures that result in malfunction of any device.

To make sure that you have a successful start with RUBY-D716VG2AR, it is recommended, when going with the boot-up sequence, to hit "DEL" key and enter the BIOS setup menu to tune up a stable BIOS configuration so that you can wake up your system far well.

### Loading the default optimal setting

When prompted with the main setup menu, please scroll down to "Load Optimal Defaults", press "Enter" and "Y" to load in default optimal BIOS setup. This will force your BIOS setting back to the initial factory configuration. It is recommended to

do this so you can be sure the system is running with the BIOS setting that Portwell has highly endorsed. As a matter of fact, users can load the default BIOS setting any

time when system appears to be unstable in boot up sequence.

### **Auto Detect Hard Disks**

In the BIOS => Standard CMOS setup menu, pick up any one from Primary/Secondary Master/Slave IDE ports, and press "Enter". Setup the selected IDE port and its access mode to "Auto". This will force system to automatically pick up the IDE devices that are being connected each time system boots up.

### **Improper disable operation**

There are too many occasions where users disable a certain device/feature in one application through BIOS setting. These variables may not be set back to the original values when needed. These devices/features will certainly fail to be detected.

When the above conditions happen, it is strongly recommended to check the BIOS settings. Make sure certain items are set as they should be. These include the COM1/

COM2 ports, USB ports, external cache, on-board VGA and Ethernet.

It is also very common that users would like to disable a certain device/port to release IRQ resource. A few good examples are

Disable COM1 serial port to release IRQ #4

Disable COM2 serial port to release IRQ #3

Etc...

A quick review of the basic IRQ mapping is given below for your reference.

Interrupt Request Lines IRQ		
IRQ#	Current Use	Default Use
IRQ 0	Unused	System Timer
IRQ 1	System ROM	Keyboard Event
IRQ 2	【Unassigned】	Usable IRQ
IRQ 3	System ROM	COM2
IRQ 4	System ROM	COM1
IRQ 5	【Unassigned】	Usable IRQ
IRQ 6	System ROM	Diskette Event
IRQ 7	Unused	Usable IRQ
IRQ 8	System ROM	Real-Time Clock
IRQ 9	【Unassigned】	Usable IRQ
IRQ 10	【Unassigned】	Usable IRQ
IRQ 11	【Unassigned】	Usable IRQ
IRQ 12	System ROM	IBM Mouse Event
IRQ 13	System ROM	Coprocessor Error
IRQ 14	System ROM	Hard Disk Event
IRQ 15	【Unassigned】	Usable IRQ



It is then very easy to find out which IRQ resource is ready for additional peripherals. If IRQ resource is not enough, please disable some devices listed above to release further IRQ numbers.

## 5.3 FAQ

### Installation Problem

#### Question: How to update the BIOS file of the RUBY-D716VG2AR?

##### Answer:

Please visit web site of the Portwell download center as below hyperlink and register an account. <http://www.portwell.com.tw/support/> Input your User name and password to log in the download center. Select the "Search download" to input the keyword "RUBY-D716VG2AR". Find the "BIOS" page to download the ROM file and flash utility.

Execute the zip file to root of the bootable USB Pen drive.

Insert your bootable USB Pen drive in RUBY-D716VG2AR board and power-on.

Input the "FPT /f XXXXX.ROM /BIOS" to start to update BIOS. ("XXXXX" is the file name of the ROM file.)

Switch "Off" the Power Supply when you finished the update process.

To short the JP1 2-3 jumper for 5 seconds then set back to normal. (Clear CMOS)

Switch "ON" the Power Supply then press the "del" key to BIOS to load "Restore Defaults" then save them to exit.

Note:

Please visit our technical web site at <http://www.portwell.com.tw>

For additional technical information, which is not covered in this manual, you can mail to [tsd@mail.portwell.com.tw](mailto:tsd@mail.portwell.com.tw) or to our sales for further assistance. Thank you.

## 5.4 System Memory Address Map

System Memory Address Map		
Memory Area	Size	Description
0000-003F	1K	Interrupt Area
0040-004F	0.3K	BIOS Data Area
0050-006F	0.5K	System Data
0070-0548	19K	DOS
0549-0FC2	41K	Program Area
0FC3-9AFF	556K	【Available】
9B00-9CFF	8K	Unused
<b>First Meg</b>	<b>-- Conventional memory end at 628K --</b>	
9D00-9DFF	4K	Extended BIOS Area
9G00-9FFF	8K	Unused
A000-AFFF	64K	VGA Graphics
B000-B7FF	32K	Unused
B800-BFFF	32K	VGA Text
C000-CE9F	58K	Video ROM
CEA0-D09F	8K	Unused